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QUEENSLAND AGRICULTURAL JOURNAL

Harvesting Grain Sorghum on the Darling Downs.

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Edited by
C. W. WINDERS, B.Sc.Agr.

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Agriculture on the Darling Downs.

J. HART, Adviser in Agriculture, Agriculture Branch.

(*Continued from page 9 of the July issue.*)

THE INFLUENCE OF SOIL, CLIMATE, AND VEGETATION ON DARLING DOWNS AGRICULTURE.

THE form of agriculture practised on the Darling Downs has been governed to a large extent by a combination of factors, the more important of which are as follows:—

1. The major soil type is self-mulching, with good moisture retaining capacity.
2. The climate of most of the Downs is characterised by an average annual rainfall of approximately 26 inches, more usually a dry winter and hot summers with erratic storm rains.
3. Although winter herbage may flourish, pastures are essentially summer growing.

Because of the rainfall distribution and extremes of temperatures, efforts to establish a permanent pasture grass, or mixture of grasses and legumes, to supply a good body of feed during both the summer and winter months of the year over most of the Downs country have been unsuccessful to date. The lack of permanent summer and winter pastures makes this area unsuitable for intensive grazing and dairying unless special measures are taken to offset this disadvantage and so the growing of both summer and winter grain and fodder crops is essential if animals are to be included in the farm programme. Accordingly, the practice of growing supplementary crops has been adopted, but as the open plain country is devoid of protection from the cold, westerly winter winds and the hot, summer days, the pasturing of stock is largely confined to the timbered areas of the eastern and western Downs country, leaving the open downs for grain production.

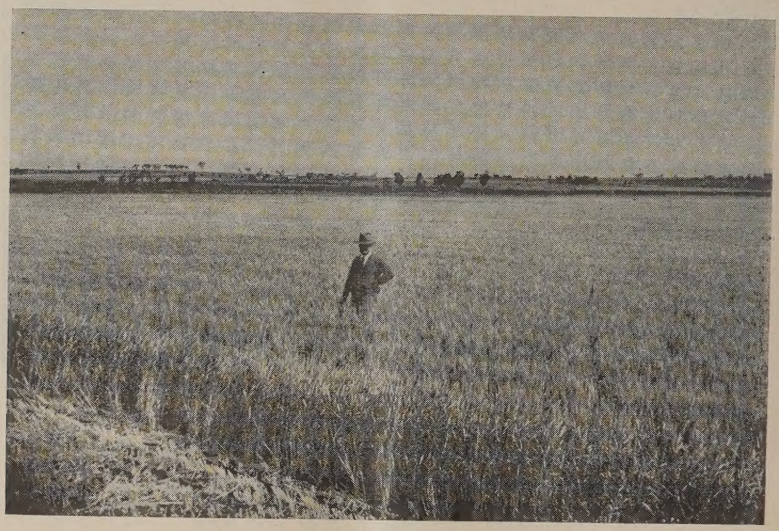


Plate 18.
SEAFOAM WHEAT, ALLORA DISTRICT, EASTERN DOWNS.

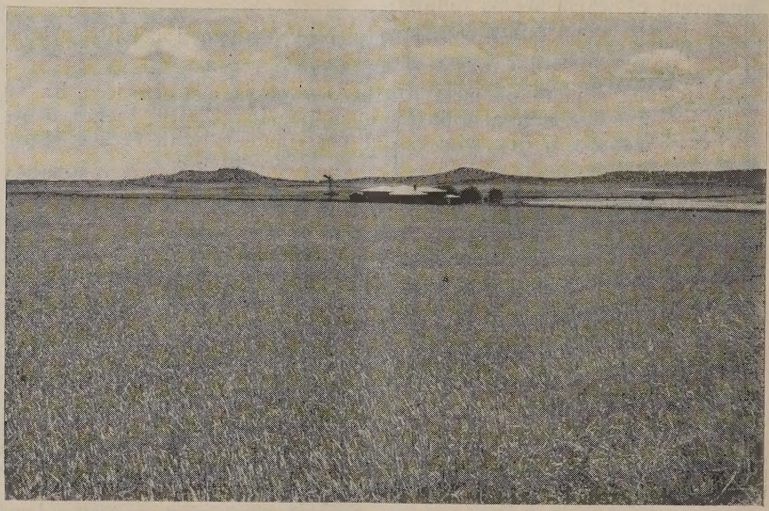


Plate 19.
WHEATFIELDS, PILTON DISTRICT, EASTERN DOWNS.

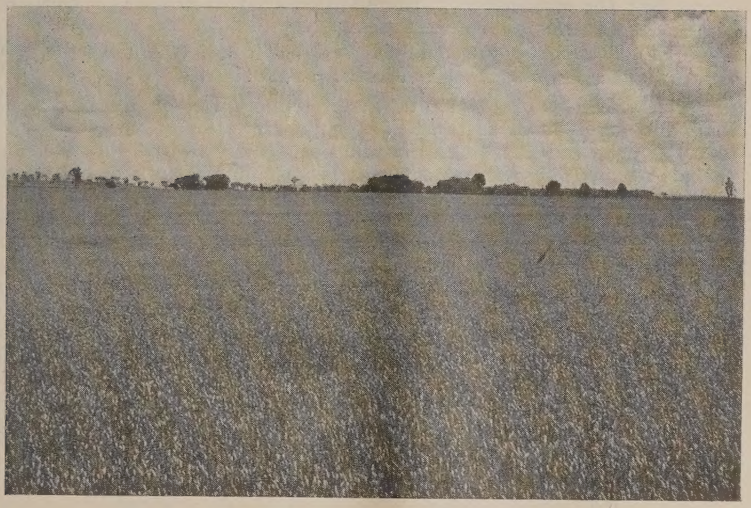


Plate 20.
Canary Seed Crop, Cambooya, Eastern Downs.

Wheat is the major crop in the grain growing areas. That a winter crop should fill this role in an area of little winter rainfall is perhaps surprising, but this has been brought about by soil and climatic factors. Firstly, summer rain is unreliable, while heat waves are often injurious to crop growth; secondly, the black earths, with their high clay content and self-mulching tendency, are ideal for fallowing and conservation of moisture.

It is, therefore, the usual practice on the Darling Downs to conserve the moisture from summer rains by fallowing, utilising such moisture for wheat production during the winter. Two suitably spaced falls of rain during the growing period of the crop are usually sufficient to ensure a profitable return of grain. That this method of agriculture has proved satisfactory for the area is instanced firstly by the fact that there has only been one complete wheat crop failure on the Downs in the past 13 years, and secondly by the fact that the Queensland average yield per acre is higher than that of any other State in Australia.

Summer grain crops are important in the cropping programme and it is a general practice for limited areas of summer crops to be grown annually. However, it is only following the partial or complete failure of the wheat crop that summer cropping becomes a major part of the farming programme of the grain growing districts.

The problems associated with agricultural practices which have been developed to meet the conditions mentioned above are numerous, and include the following:—

(1) The selection of an economic crop rotation.

(2) The extension of agricultural practices designed to retain soil fertility.

(3) The establishment of a nutritionally well balanced permanent pasture.

(4) The incorporation of effective soil conservation practices in the farming programme, where required.

The objectives of (1) and (2) are similar but their application is limited by an economic factor. For example, a rotation of wheat followed by a row crop and then lucerne would perhaps be effective in satisfying (2) above, but where wheat can still be profitably grown on the same land year after year a farmer adopting such a programme would suffer financial loss, especially during the present era of high grain prices. Again, burning the wheat stubble is commonly practised on many farms for the purpose of facilitating cultivation and the preparation of the seed-bed for the next wheat crop. This is almost universally accepted as an undesirable practice, but because there is, as yet, little apparent deterioration in soil fertility and wheat yields in the main grain areas, trash conservation is not regarded as economic by most farmers on the Darling Downs.

The main farming activities on the Darling Downs may be grouped as (1) grain growing; (2) dairying and mixed farming; and (3) crop fattening—sheep and cattle. These activities are discussed in the following sections.

GRAIN GROWING.

The grain crops grown may be divided into two well-defined groups —winter crops and summer crops. The former includes wheat, oats, barley, linseed and canary seed; the latter, grain sorghums, millets, maize and sunflowers.

Farms in the grain growing areas vary considerably in area, but generally range between 600 and 1,000 acres, with occasional properties up to 1,500 acres. The farm plant varies with acreage, but would include one or more of each of the following:—tractor, sundercut, scarifier, stump-jump harrows, combine, header-harvester and a medium-sized motor vehicle. The outlay for plant alone would, on present day prices, approximate £3,000. Where larger than average areas are farmed, the outlay for machinery would be considerably greater.

Wheat.

The wheat industry in Queensland is well organised. Between the two world wars the marketing of the State wheat crop was subject to the operation of the Wheat Pools Act under which the State Wheat Board was constituted. This Board performed all the marketing functions on behalf of the growers. During the second world war, the industry was subject to the control of the Australian Wheat Board, operating under emergency legislation. Since the enactment of the Wheat Industry Stabilisation Act of 1948 the Queensland wheat industry has been incorporated as an integral part of the Commonwealth stabilisation plan in which the State Wheat Board retains autonomy. The State Board selects, grades and distributes seed wheat, covers compulsory hail insurance on crops, procures and delivers bags for harvesting, and stores the grain.

The crop, mainly planted in June, is normally harvested in November. As the summer storm period usually commences in November, an essential requirement of wheat growing in this area is the rapid clearing of the harvested grain to the wheat dumps.

Three desirable characteristics of wheat varieties for the Downs are rust resistance, drought resistance and earliness of maturity. Varietal improvement along these lines is continually being investigated by plant breeders of the Department of Agriculture and Stock and today growers have a number of excellent wheat varieties from which to choose when arranging their plantings.

The area sown to wheat during 1948 was approximately 630,000 acres, giving an estimated yield of about 14 million bushels. Individual yields of up to 60 bushels per acre were recorded in this season, but an average yield per acre on good wheat land on the Darling Downs over a number of years would be in the vicinity of 21 bushels.

Oats, Barley, and Canary Seed.

These crops, which require a similar mode of handling to wheat, are grown in conjunction with that crop, but are more commonly used as winter fodders. Oats, in particular, are used for this purpose since the Downs has not proved as suitable for oat grain production as the oat districts of the southern States. The estimated production of these grains on the Downs for the year 1948 is as follows:—

	Acres	Bushels
Oats	9,000	240,000
Barley	4,000	150,000
Canary seed	5,000	60,000

The areas planted to these crops vary considerably from year to year, the acreages depending on the current market values of the grains, particularly in the case of canary seed.

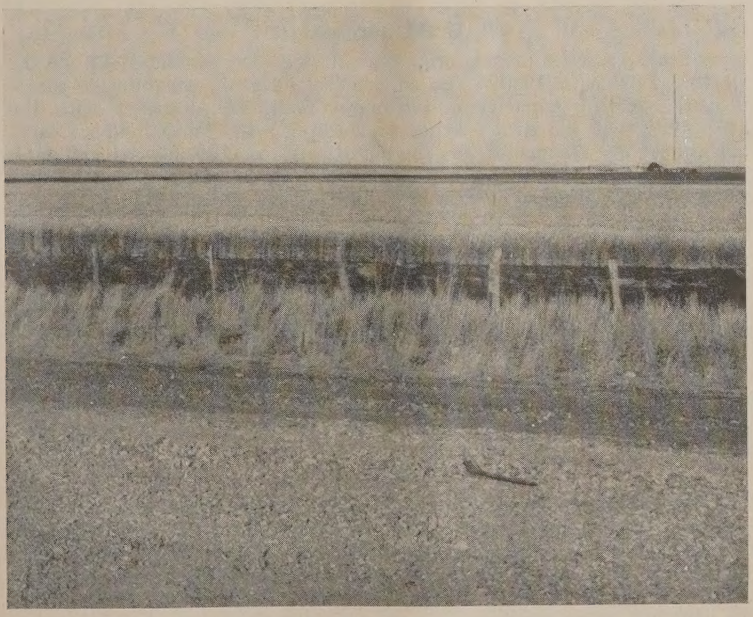


Plate 21.
WHEATFIELDS ON PLAIN COUNTRY IN THE DALBY DISTRICT.

Linseed.

At present, linseed is in its early stages of establishment as a commercial crop on the Darling Downs. Results to date indicate that linseed can be grown successfully in this area and expansion of the industry is expected if prevailing high seed prices continue. The crop can be handled entirely by wheat farm machinery and this factor alone greatly favours crop expansion.

The area sown to linseed on the Downs in 1948 was approximately 6,000 acres. An average yield of 6 to 9 bushels per acre was well below the previous season's yield of 12 to 15 bushels per acre from approximately 150 acres. This reduction in yield was almost wholly due to corn ear worm attack. This pest atacked the crops soon after flowering commenced, the larvae causing considerable damage to the developing seed bolls. Control of the pest can be obtained by spraying or dusting with DDT. The large areas are suitable for aerial treatment with the insecticide, but for smaller areas power-driven dusting or spraying plants mounted on suitable vehicles are sufficient.

The outbreak of corn ear worm in this crop was exceptionally heavy in 1948, but such serious infestations are not normally expected. The susceptibility of linseed to this pest, however, may be a limiting factor to its expansion.

Investigation of cultural methods such as time of planting and seeding rate offer hope for control of the pest. Brief experience to date suggests that crops planted in late autumn or early winter are less liable to severe pest losses than crops planted later.

Grain Sorghum.

Dwarf varieties of this crop were first grown commercially on the Darling Downs in 1939. The superiority of grain sorghum to maize in both yielding capacity and drought resistance, together with the adaptability of the dwarf types to working with normal wheat farm machinery, are responsible for the popularity the crop has enjoyed since its introducion. As mentioned previously, the area sown to this crop fluctuates according to success or failure of the wheat crop.

A conservative average yield of grain sorghum would be 30 bushels per acre, but crops of 120 bushels per acre have been recorded in the district. The average yield of 40 bushels per acre for the 1946-47 crop was phenomenal in that two crops were harvested from the one planting in many instances, due entirely to unusually favourable seasonal conditions.

Normally, the crop is planted as early in summer as possible. Late sown crops are liable to be heavily infested with sorghum midge and suffer severe damage or even total loss.

Maize.

The popularity of maize has declined since the introduction of grain sorghum, the estimated area on the Downs during the 1947-48 season being 7,000 acres, producing 70,000 bushels of grain. The uncertainty of summer rains on the Darling Downs is unfavourable to maize production, as the crop requires rain at the flowering stage for cob development. In contrast, grain sorghum is more resistant to dry conditions.

An average yield of maize would be 18 to 24 bushels per acre, but yields of up to 60 bushels have been recorded. Generally speaking, there are two planting periods for this crop—early summer and mid-summer (that is, late September and January). These planting times have been arranged so that final development of the plant is possible either before or after the harsh conditions of midsummer.

Maize is not a crop of the main grain-producing areas, its culture generally being confined to mixed farming areas of the eastern and north-eastern portions of the Downs. Although it can be harvested fairly satisfactory by the sturdier makes of header-harvester, and although some special maize picking machines are operated in the area, the general practice is to hand-pick the cobs, which are later threshed out through a stationary thresher.

Hybrid maize varieties suitable for the various maize districts of the Downs are being evolved by the Queensland Agricultural High School and College and it is anticipated that within a few years seed will be available for large commercial plantings. The yield increase already shown by hybrid varieties tested may revive the popularity of this crop. However, in the light of present day comparisons between the two crops, maize and grain sorghum, it is difficult to see the former replacing the latter as a crop in the grain growing districts of the Darling Downs.

Millets.

Under this group come the following types, all of which are grown in varying amounts over the Darling Downs:—Setaria (panicum), white panicum, white French millet, Japanese millet and Hungarian millet. Of these, setaria, white French and Japanese millets are the most popular in this area, the acreages and yields for the 1947-48 season being estimated as under—

	Acres	Bushels
Setaria (panicum) ..	5,000	165,000
White French	5,000	115,000
Japanese	3,000	105,000

Setaria (panicum) and white French millet are grown almost solely for grain whilst the other types serve a dual purpose, being grazed and then allowed to go to seed. These latter types are more commonly grown on the mixed farming areas of the Downs.

Sunflowers.

It is estimated that approximately 5,000 acres of sunflowers were sown during the 1947-48 season. This hardy summer crop, giving an average yield of one half-ton of seed per acre, is becoming increasingly popular. It is, perhaps, the most drought resistant of all cultivated summer crops on the Downs, and this characteristic, coupled with the suitability of the crop for handling by wheat farm machinery, is a major cause of its increased popularity.

At present, Giant Russian is the variety in general production, but the suitability of mid-dwarf and dwarf varieties such as Mennonite and Sunrise is being investigated. These varieties are more easily handled by the header-harvester than Giant Russian.

Killarney and Nobby are the two chief sunflower growing areas of the Downs, but expansion to other districts is highly probable.

HORTICULTURAL CROPS.

Apart from a few small crop or truck crop areas in or around the main centres, horticultural crops are of no appreciable commercial value on the Darling Downs. However, most vegetable and temperate fruits grow quite readily in the district.

WEED PROBLEMS.

A number of weeds of considerable economic importance occur on the Darling Downs, the most important being mint weed (*Salvia reflexa*), wild turnips (*Raphanus raphanistrum* and *Rapistrum rugosum*), Johnson grass (*Sorghum halepense*), nut grass (*Cyperus rotundus*), and a number of deep-rooted weeds, such as *Senecio* sp. and *Centaurea* sp. which only recently have been reported as being troublesome.

Mint Weed.

Although most serious on the black earths of the Downs, mint weed grows on all soil types found in the area. The main conclusions reached by officers of the Commonwealth Council for Scientific and Industrial Research following a survey of the mint weed problem in 1946 and 1947 were as follows:—

(1) Losses of grazing animals from poisoning can be avoided if precautions are taken to prevent hungry stock entering dense mint weed.

(2) Pastures are not invaded unless the vigour of the stand has been reduced by mismanagement. Once the weed is established in a pasture its dominance is assured unless the intensity of grazing is greatly reduced.

(3) Mint weed is not normally of importance in wheat growing or in the production of winter fodder crops. With summer cereals, on the other hand, mint weed is often able to dominate a crop in the early stages of its establishment.

Mint weed, like other annuals, can be kept in check by cultivation, but the most efficient cultural practices in seed-bed preparation and inter-row tillage have not yet been determined. Urochloa grass has in some areas choked out the mint weed, but except on the eastern fringe, where the grass itself is becoming a pest of cultivations, it does not usually grow sufficiently vigorously to control the weed.

Hormone-type weedkillers are effective against mint weed, but the question of using these weedicides on an extensive scale against a free-seeding annual is an economic one.

Wild Turnips.

These winter growing weeds, commonly found over most of the open downs country, are pests of major economic importance to the wheat grower. As well as being serious competitors of the cereal crop itself, they produce woody seed stalks which present a difficult problem to the wheat harvesting machinery.

These pests can now be effectively controlled by the use of hormone-type weedkillers at a cost approximating 3s. per acre for materials. Best results are obtained while the plants are in the seedling stage. A machine capable of spraying 100 acres a day can readily be constructed on the farm.

Johnson Grass.

Johnson grass, a member of the sorghum family, is a fairly prevalent pest in the eastern Downs districts, having been introduced often among Sudan grass seed. The plant is similar in general appearance to Sudan grass but has a strongly developed system of rhizomes, or underground creeping stems, which persist after the aboveground portions are destroyed. It is generally considered to be the most poisonous of all the sorghum group.

Eradication by cultural methods alone is difficult and impracticable. A solution of sodium chlorate at a concentration of 1 lb. to 1 gallon of water will effectively control this weed, although the material is expensive. However, for controlling small patches of Johnson grass its use is strongly recommended.

Nut Grass.

Because of the rather severe winters on the Darling Downs, the introduction of nut grass was not viewed with much concern. However, in recent years it has attained some importance on the eastern Downs soils, where on some farms it has become a major pest. It has proved to be a serious competitor for moisture among summer crops, while summer fallowing for winter crops may be rendered ineffective by its presence. There is no known practical control for this pest.

DAIRYING AND MIXED FARMING.

Generally speaking, dairying on the Darling Downs is confined to the sheltered timbered zones previously mentioned. There are two distinct district areas:—

(*a*) the undulating and hilly country of the eastern, north-eastern and northern Downs, with centres such as Toowoomba, Oakey, Crow's Nest, Pittsworth and Warwick;

(*b*) the brigalow-belah and open box country of the western and north-western Downs, with centres such as Dalby, Bell, Jandowae and Warra.

The dairying industry, though well organised as far as factory distribution is concerned, is less amenable to efficient management than is the grain growing industry. This can be attributed, perhaps, to the fact that dairying, more especially in the eastern zone, is generally conducted in association with mixed farming. It is obvious that, where a farmer has to cultivate both summer and winter fodders, the temptation to utilise these crops as cash crops whenever possible is great and this is quite often to the detriment of the herd. In spite of this disadvantage, however, the annual return per cow on the eastern Darling Downs is higher than that of any other district in the State, being in the vicinity of 200 lb. of butterfat per year. In most other Queensland districts, however, permanent pastures are established, so the higher production on the Downs is offset to some extent by necessary cultivation and cropping costs.

The Eastern Districts.

These districts are first class dairying areas, the lack of good winter rains being their main drawback. It is considered that a more stable dairying industry could be effected by the inclusion of more fodder conservation in the farming programme and more efficient cropping and grazing of fodder crops.

If farmers would set aside a percentage of cash crops towards the building up of reserve fodder, the problem of fodder conservation would be largely overcome. Silos in general, because of the time, labour and expenditure in installing, filling and emptying, are not favoured by farmers in these districts, where much time is involved in the cultivation of the land to produce the necessary all-the-year-round fodder. An alternative is the inclusion of lucerne stands in the cropping programme and the storing of hay therefrom. When not required for hay such stands can be grazed. Lucerne hay fed with sorghum grain, which is produced on most dairy farms, would supply a very useful ration to tide stock over the dry periods usually experienced in this area.

With the introduction of the pick-up hay baler, the making and storage of hay has become a simple matter. Whilst these machines are generally too expensive for individual farmers to purchase, co-operative machinery pools can effectively control and profitably maintain them. The Darling Downs Co-operative Dairy Association has two such pools in operation at the present time, one pool working the eastern Downs and one the western area. Pick-up balers owned by other machinery pools and private contractors also operate throughout the area.

The normal size of dairy farms in these districts would vary from 120 to 320 acres, with some farms over 500 acres in area. Carrying capacity is largely dependent on the extent to which the owner indulges in mixed farming. An average holding would carry about one beast to six acres. It is emphasised that this capacity could be increased if the farmer were to concentrate solely on dairying. The original outlay in equipping such a farm is, as in the grain growing areas, fairly high. Similar implements are required for the land cultivation, but not, of course, as large as those used in the grain growing districts.

The bulk of the farm dairy produce is made into butter, factories being established at Crow's Nest, Goombungee, Oakey, Toowoomba, Clifton, Allora, Killarney and Warwick. Thirty-one cheese factories are scattered over the area, but mostly around Pittsworth and the Maclagan-Quinalow districts, and there is an increasing fresh milk supply trade. Brisbane distributing and processing firms are already being supplied with milk from this area.

Pig raising is associated with dairying except where a farmer is supplying fresh milk. The pig industry is extremely valuable in this area. The Darling Downs Co-operative Bacon Association, which handles much of the Darling Downs output, killed 100,000 pigs during 1946-47 and 67,000 during 1947-48 at its Downs factory. During 1947-48, the wholesale selling value of its products was over £780,000.

The main cultivated fodder crops used in the eastern dairying districts are wheat, oats, barley, and canary seed as winter feeds, and Sudan grass, Japanese millet and lucerne as summer fodder. It is only during a mild winter that lucerne supplies a body of feed during this time of the year. Although grazing of Sudan grass is a long established practice over the whole of the Downs, it must be emphasised that this grass, like all other members of the sorghum group, may be poisonous to cattle at certain periods, more especially when the plants are wilted during a dry spell. A supply of one of the effective antidotes to this poison should be kept on hand.

The Western Districts.

This group of districts, which embraces much of the brigalow-belah and open box country, is mainly an area of permanent pastures. Here, as previously mentioned, Rhodes grass is the major fodder. Recent years, however, have seen the introduction of some crop cultivation for both winter and summer fodders.

The problems outlined for the eastern districts apply to this area also. An outstanding need is the inclusion of a suitable legume in the Rhodes grass pastures. At the present time, lucerne is considered the most satisfactory.

Farm size in these areas is much larger than in the eastern districts, varying from 600 to 1,000 acres and over; but here, where the pasture grass is mainly summer growing, the carrying capacity of the land is necessarily reduced to enable the stock to carry over during the winter months. Carrying capacity of these areas is about one beast to 6–8 acres. This carrying rate compares favourably with that of the eastern districts, but it must be remembered that whilst farmers in the latter area indulge in mixed farming western district farmers concentrate almost solely on dairying.

The return per cow in this area averages about 160 lb. of butterfat per year. Output, of course, fluctuates, being high in the summer months and low during the winter period, while that of the eastern districts is comparatively regular throughout the year.

Practically the whole of the dairy farm produce is manufactured into butter by the factories at Jandowae and Dalby. Cheese production is of little account, the only factories in the area defined as the western districts being at Yamsion, Irvingdale, Sunnyvale and Cooranga North.

The distance of these centres from the big cities gives little opportunity at present for a fresh milk trade.

CROP FATTENING.

Crop fattening of sheep and cattle is becoming an important industry on the Darling Downs, and is generally conducted in conjunction with grain growing. At present, emphasis is on the production of grain, with crop fattening filling a secondary role. It is natural, of course, that the relative popularity of grain production and cattle fattening should be wholly determined by the relative prices of grain and meat. The two industries, however, can be combined with considerable success.

Important factors in successfully combining grain growing with crop fattening are, firstly, the purchasing of stock from western Queensland districts during the late summer or early winter months and selling on the high market of late winter; secondly, the selection of dual purpose cereal varieties which will supply a heavy body of feed and still give good grain yields; and thirdly, well organised grazing methods.

The matter of purchase and sale of stock is entirely the concern of the individual farmer, but in purchasing a buyer must be sure that his crop is sufficiently rooted to withstand grazing and that he will have enough green fodder to carry the beasts through to their peak

condition. Should the latter not be achieved, the low prices received for the animals may be insufficient to offset the loss of grain occasioned by the grazing of the crop.

Wheat (Plate 22), oats and canary seed are the popular crops used for fattening. Oats are quite often planted solely for feed purposes, whilst wheat is generally planted with the object of obtaining a grain crop after being grazed. Most of the commoner oat varieties have proved satisfactory, the popular choices being Fulghum and Algerian. Victoria x Richland and Klein, two newly introduced varieties, are rapidly coming into favour.

Plate 22.
Lambs Being Fattened on Wheat.

Slow maturing wheat varieties evolved for the dual purpose of grazing and grain production are available, the most popular being Warput and Ford. Yalta is a new rust-resistant variety from New South Wales which also appears suited for this purpose, and Florence x College is a new Queensland strain which is highly resistant to rust and gives great promise as a dual purpose variety for early planting.

In the grazing of crops intended for grain, a number of points require attention. Rapid feeding-off with a large number of animals is preferable to an extended grazing by a small herd or flock; grazing should not commence until plants are firmly rooted, as young plants are easily pulled out by sheep and cattle; to reduce trampling damage, stock should not be allowed to graze in crops during wet weather if it can be avoided; and finally, in crops intended for grain, grazing should cease before the developing heads, sheathed within the leaf stems, are high enough from the ground to be eaten by stock.

Quality of Seeds for Sowing.

F. B. COLEMAN, Standards Officer, Standards Branch.*

SEED can be defined as "The germ from which a plant can be reproduced."

It is an interesting experiment to take a few bean seeds and place them on a plate covered with very damp cloth, flannelette or towelling. If the seed is covered with another plate to retard evaporation, and kept warm, root and stem growth can be watched every day.

As the root and stem grow, it will be observed that the seed leaves grow smaller, their function being akin to a "baby's bottle" which enables the little plant to live until it has established itself in the soil.

After germinating in the field the plant will run its life cycle and produce another crop of seeds which can be harvested. In the process of harvesting, some inert matter and weed seeds may be unavoidably included with the seeds of the cultivated plant. Various processes of cleaning are therefore required before the seed is fit for sale.

Sampling.

The quality of seeds for sowing can be ascertained by examination of a sample to determine its composition and the ability of the seed to produce healthy root and stem growth in a given number of days.

Great care is necessary to ensure that the sample truly represents the bulk. It is therefore taken from the top, centre and bottom of as many containers as possible.

The sample to be examined is first numbered, then thoroughly mixed and spread out on a sheet of plate glass. By the aid of a spatula, several portions are lifted from different parts until a sufficient quantity is obtained to enable a purity test to be made. In the case of beans, 200 grams are required, cowpeas and wheat 100 grams, millets 30 grams and grass seeds 10 grams.

This weighed portion is then spread out, and with the aid of a small spatula the seed is divided into fractions of the seed under consideration—called purity, seeds of other crop plants, prohibited seeds, restricted seeds, weed seeds and inert matter, which includes broken seeds less than half of a complete seed in size. Each of these parts is weighed and calculations made.

In the case of barley, beans, cowpeas, maize, oats, peas, wheat, and seeds of like size, the number of restricted weed seeds per pound should be calculated, and in the case of seeds of smaller size the number of restricted weed seeds per ounce should be ascertained.

Testing.

The seed under consideration is now placed out to germinate by taking three lots—each of 100 seeds (that is, pure seed)—and spacing them evenly on a piece of moist flannelette, which has been first placed on a tray. The moisture is varied according to the seeds' requirements, and the seeds kept covered with a sheet of glass to prevent excessive evaporation. The three lots are marked A, B and C for reference purposes.

The trays must be placed in incubators suitable for the germination of the seeds concerned. Winter-growing crops require coolness, while summer-growing crops need a warm temperature. In actual practice,

* An A.B.C. "Country Hour" Talk.

alternating temperatures or controlled temperatures ranging from 68 deg. to 104 deg. F. are used.

The number of seeds which germinate -that is, produce strong, healthy roots and stems—are recorded and removed from the tray every day.

Frequently leguminous seeds which remain unswollen when the germination test is ended are met with. All or some of these seeds would germinate when placed in the soil. Therefore in the case of lucerne, cowpeas, rice beans and crotalarias, all the hard seeds, in the case of red clover half the hard seeds and in the case of other legumes one-third of the hard seeds, are included in the germination count.

Because of the very large proportion of hard seeds, and difficulties associated with germination tests brought about by the presence of moulds, the seeds of Mauritius and velvet beans are abraded before the test is made.

Normally seeds reaching maturity on the parent plant fall to the ground and germinate when conditions are suitable. Man in his haste to harvest the seed often defeats Nature's object and the seed may be offered for sale before it is fully mature. If such seed is stored under good conditions, maturation is usually reached by the time of sowing.

Short cuts to hasten maturity, such as pre-chilling, drying, etc., are used in seed testing stations in order to ascertain the maximum possible germination of seeds such as Rhodes grass, paspalum, prairie grass and oats.

Comparison of Seed Lots.

From the records made, particulars regarding speed and uniformity of germination may be obtained, in addition to total germination percentages. The percentage of "pure germinating seed"—that is, the proportion of the bulk that will grow (which is a true indication of the value of a seed sample)—is based on purity and germination, and is obtained by multiplying the percentage of pure seed by the percentage of germination and dividing by 100.

The result enables a comparison to be made of various lots of seed with differing purities and germination, and also shows if the sample complies with the prescribed standards. For example, two samples of seed of like purity and different germination are offered for sale at 3s. 6d. and 3s. 3d. per lb. They have a pure germinating seed figure respectively of 95 per cent. and 74 per cent. Thus you would pay 3s. 8¼d. for every pound of pure germinating seed in the first sample and 4s. 4¾d. in the case of the lower priced seed. The so-called "cheaper" line is actually 8½d. per lb. dearer than the so-called "dearer" line, when the actual amount of seed that will grow is taken as the basis of calculation.

Taking 1 lb. of average lucerne seed as containing 210,000 seeds, each pound of seed as purchased should in the case of the 3s. 6d. per lb. seed produce 199,500 plants, and the 3s. 3d. per lb. seed 155,400 plants.

If these two samples were sown at the rate of 12 lb. per acre of pure germinating seed—the actual seed that will grow—100 lb. of the 3s. 6d. seed would plant approximately 8 acres, and 100 lb. of the 3s. 3d. seed would plant approximately 6 acres.

Seeds for sowing should be free from impurities, of high germination, and of known strains. Price is a secondary consideration to keen farmers who are interested in quality.

Plate 23.

Linseed Variety Trial, Regional Experiment Station, Hermitage, 1948.—Varieties (from left to right)—Meggitts' Walsh, Bolley Golden, Morocco.

Plate 24.

Tobacco Experiment Plot, Regional Experiment Station, Ayr.

Horticultural Districts of Queensland.

1.—THE GRANITE BELT.

F. A. L. JARDINE, Adviser in Horticulture.

WHAT is in some ways the most important fruit and vegetable growing district in Queensland is situated on the southern border of the State 200 miles south-west of Brisbane. This area is widely known as the Granite Belt and extends from Wallangarra on the border of Queensland and New South Wales in a northerly direction to Dalveen, a distance of 40 miles. The district varies in breadth from 5 to 17 miles. Stanthorpe (Plate 25) is the chief town serving the business and other needs of the district. Excellent roads connect Stanthorpe to Brisbane and the main coastal resorts of southern Queensland.

Plate 25.

VIEW OF THE TOWN OF STANTHORPE, MAIN BUSINESS CENTRE OF THE GRANITE BELT.

The Granite Belt first came into prominence as a tin producing area about 70 years ago. Fruit and vegetable production commenced some 30 years later, but progress was comparatively slow until a rapid development took place after the first World War when many ex-servicemen and others settled in the area. Some of the smaller townships in the district commemorate the exploits of Australian troops in such names as Pozieres, Amiens, Bullecourt and Fleurbaix.

Climate.

The Granite Belt forms part of a plateau which is 2,500 to 3,500 feet above sea level. The climate, as indicated by Table 1, is therefore mainly temperate. The range of temperature varies considerably between summer and winter. High maximum readings between 90 deg. and 95 deg. F. are recorded during the summer, though the nights are invariably cool. Severe frosts occur during the winter months with grass readings as low as 5 deg. F. Snow is, however, a rare phenomenon.

TABLE 1.
CLIMATIC DATA—STANTHORPE.

	January	February	March	April	May	June	July	August	September	October	November	December	Year
Mean Maximum Temperature in ° F. ..	81·1	79·6	76·0	72·6	64·3	58·7	57·3	60·8	66·8	73·5	78·4	80·9	70·8
Mean Minimum Temperature in ° F. ..	59·0	59·1	55·6	50·4	40·7	36·6	33·2	35·0	40·9	47·8	53·4	56·8	47·4
Average Rainfall in Points	359	328	270	172	185	196	203	182	228	255	269	351	2,998

The Granite Belt has an average annual rainfall of 30 inches, most of which falls during the summer and in that season can be regarded as fairly reliable. Winter and early spring rains are very variable. However, there is usually ample soil moisture during this period because of the mildness of the weather and the low rate of evaporation. A knowledge of local conditions is a great help to the farmer in planning the year's programme, particularly when vegetable crops provide the major part of the farm income.

Soils.

As is suggested by the name Granite Belt, the soils of the district are derived from granitic rock. The slow process of disintegration of granite boulders over the ages is reflected in a range of soil types. Some soils are coarse, sandy loams of considerable depth where they occur in hillside pockets and valleys. Others are of a much finer texture and of variable depth, overlying a stiff impermeable clay subsoil. The deeper soils are, of course, the most suitable for horticultural purposes.

Soils of the granitic type erode very easily during periods of heavy rain, and loss of top soil has certainly lowered the productivity of many farms. Protective measures and, in some cases, remedial measures should, therefore, be an essential feature of soil management practices. Contour planting for both annual and perennial crops is desirable, but even this must be supplemented by the systematic planting of green manure cover crops. The most generally used cover crop is New Zealand blue lupin, which, when planted in late February or March, makes good growth at a time of the year when the soil moisture is adequate. The

crop is either ploughed into the ground or disced and left on the surface as a "blanket" mulch, the latter method being preferable. Summer green manures which would be planted in October are seldom used, for at this time of the year competition for soil moisture might adversely affect the trees. Weed growth is, however, allowed to form a ground cover when the summer rains have begun.

Timbers.

Cypress pine, stringy bark, messmate, yellow box, cabbage gum and wild apple are among the most common of the natural timbers. A wide range of wattles is also to be found in the district; the bark of one variety (black wattle) finds a ready market for tanning purposes. About 1,200 acres of land, most of which is unsuitable for horticultural purposes, have been planted to exotic pines.

Horticultural Uses.

Temperate fruits and a number of vegetables are grown extensively in the Granite Belt (Table 2). Of the several fruits, apples, grapes, pears, plums, peaches and apricots are the most important. Stone fruits are grown throughout the district (Plate 26) but vineyards are mainly established in the south and apple (Plate 27) and pear orchards at the northern end. How far this aggregation can be attributed to the suitability of the soils and climate for the crops concerned is a debatable point. Excellent quality fruit can be grown and pest and disease control measures are adequate for requirements. The main hazards are hail and frost. Late spring frosts are not uncommon and they may occur after the trees or vines have commenced to make new season's growth. Heavy losses have been recorded from time to time, as in the season 1948-49.

Plate 26.
A TEN-YEAR-OLD PEACH ORCHARD AT BROADWATER.

Plate 27.
An Apple Orchard at Applethorpe.

TABLE 2.

Granite Belt Production Data (1948).

Crop.	Production.	Acreage under Crop.		
		Bearing.	Non-Bearing.	Total.
Apples	455,254 bushels	4,911	1,097	6,008
Pears	38,498	301	118	419
Plums	67,353	886	355	1,241
Peaches	83,961	1,105	358	1,463
Apricots	22,386	250	117	367
Grapes	5,576,645 pounds	1,830	273	2,103
Tomatoes	270,874 ½-bushels	..	..	1,460
Beans	90,986 bushels	..	..	1,079
Cabbages and Cauliflowers ..	58,074 dozen	..	..	528

Growers with less than 10 acres cropping 112
Growers with more than 10 acres cropping 623

The principal vegetables grown in the district are tomatoes, beans and the two common crucifers, cabbages (Plate 28) and cauliflowers. Under sub-tropical conditions, all of these are normally grown during the autumn and winter months. The more temperate climate of the Granite Belt favours their production during the summer, when Queensland and some southern markets are under-supplied. The relatively dry climate tends to check the development of fungus diseases, which are apt to be a trouble in other parts of the State. If the rainfall is adequate, excellent crops of high quality produce are grown.

Few farmers are in a position to irrigate—surface water is sparsely distributed over the district, while underground supplies are limited and often unsuitable for the purpose. Vegetable crops are, therefore, somewhat speculative, for dry weather during the early stages of growth may give crops a setback.

Plate 28.
A CABBAGE CROP IN THE STANTHORPE DISTRICT.

The more important varieties of fruit and vegetables grown in the district are:—

Apples—Lord Nelson, Granny Smith, Jonathan, Delicious, McIntosh Red, Stayman's Winesap and Gravenstein.

Pears—Williams' Bon Chretien, Packham's Triumph and Clapp's Favourite.

Peaches—Wiggins, Blackburn Elberta, Mayflower, J. H. Hale, Dripstone Elberta and Golden Queen.

Japanese Plums—Wilson, Santa Rosa, Burbank, Doris, Narrabeen and October Purple.

English Plums—Pond's Seedling, Grand Duke, Angelina Burdett and President.

Grapes—Chaouch, Muscat Hamburg, Gros Colman, Waltham Cross and Purple Cornichon.

Tomatoes—Sioux, Grosse Lisse, Valiant and Rutgers.

French Beans—Brown Beauty.

Cabbage—Succession.

Cauliflowers—Early Phenomenal.

Almost all the fruit and vegetables are sold on the fresh produce market. Very little of the produce is canned, dried or processed. The main market outlets are in Queensland and New South Wales, and the

bulk of the produce passes through the metropolitan markets at Brisbane and Sydney respectively. Limited cold storage facilities are available in the district. These are used mainly for apples but they also serve a useful purpose in pre-cooling fruit and vegetables for subsequent transit in iced railway wagons to North Queensland.

Size of Holdings.

The size of the farm unit varies with the type of country available. Where the topography is easy and the soil relatively fertile, properties may not exceed 25 acres and settlement is comparatively close. Frequently, however, horticultural soils are situated as pockets in the middle of inferior soils of little value and many holdings are consequently more than 20 acres in extent.

The Future.

Fruit and vegetable growers in the Granite Belt have had good and bad times but the district has, nevertheless, made steady progress. It can scarcely be displaced from its present unique position in the horticultural economy of the State. Progress has been developed along sound lines, particularly in the past 10 to 12 years when many varieties of trees and vines have been grafted to more popular and profitable types. Careful consideration has been given to the selection of suitable varieties for the planting of fresh areas, and growers generally are becoming more conscious of their obligations regarding soil improvement and maintenance as well as pest and disease control.

The annual export of approximately 50,000 cases of apples helps considerably in relieving the local markets. The work done in the transportation of perishable fruit and vegetables to the far north of the State by ice-cooled railway wagons has proved satisfactory, and when put into more general use should help considerably in the distribution of much of the district's produce to the outlying areas of Queensland. There is still ample room for an expansion of the area under crop as well as the more efficient use of existing cultivated areas. The Granite Belt must, therefore, grow in importance to meet the demand which an increasing State population will inevitably create for its produce.

Junior Farmer Club Notes.

New clubs have recently been formed at Goombi and Burncluith, in the Chinchilla district. Goombi officers are Ben. R. Walsh (Club leader), John Ridge (deputy-leader), and Noel Fisher (secretary-treasurer). Burncluith's Club leader is Ray Roberts; N. Stark is deputy-leader, and Leslie H. Wolski secretary-treasurer.

The following members have been selected for the Junior Farmers' Camp at the forthcoming Brisbane Show:—Marshall Muller (Allora), John J. Coombes (Bauple), Charles W. Hill (Biloela), Allan Harm (Cloyna), Colin Wedemeyer (Gayndah), Ben. R. Walsh (Goombi), Donald M. Cunningham (Goomboorian), Vincent E. Walker (Mondure), Claude Scheiwe (Murgon), Noel Dreger (Mount Murchison), William F. Rowe (Thangool), Colin Mansfield (Tiaro), Norman Munckton (Theodore), Douglas K. Madsen (Warwick), and Edgar B. Horne (Wondai).

Star Thistle—A New Weed Pest.

C. T. WHITE, Government Botanist.

A WEED that may possibly develop into a serious pest of agricultural areas appeared in 1948 in the Fassifern Valley in south-eastern Queensland. The plant is a native of southern and western Europe and is well established as a common and aggressive weed in the southern States of Australia.

Description.

Star Thistle (Plate 29) is a biennial or perennial intricately branched spreading weed, two to three feet tall, and inclined to become somewhat woody when old. The leaves are dull green, almost two inches long, and deeply lobed to the midrib. The flowers are lilac or pale purple and are borne in the centre of a mass of spiny, rigid, pale straw-coloured bracts. The seeds are one-eighth of an inch long, pale gray or straw-coloured streaked with brown.

Botanical and Common Name.

The plant is known botanically as *Centaurea calcitrapa*. Star thistle is the standardised common name. Other thistles occurring in Queensland have been called star thistle, but they differ from this pest in having yellow flowers and in being annuals.

Control.

So far as is known, the weed occurs in Queensland only in isolated patches, and hand-pulling or cutting off several inches below the soil surface is probably the most effective means of eradication. Experience in the southern States suggests that hormone-type weedkillers may be of use against infestations that cannot be dealt with by normal methods.

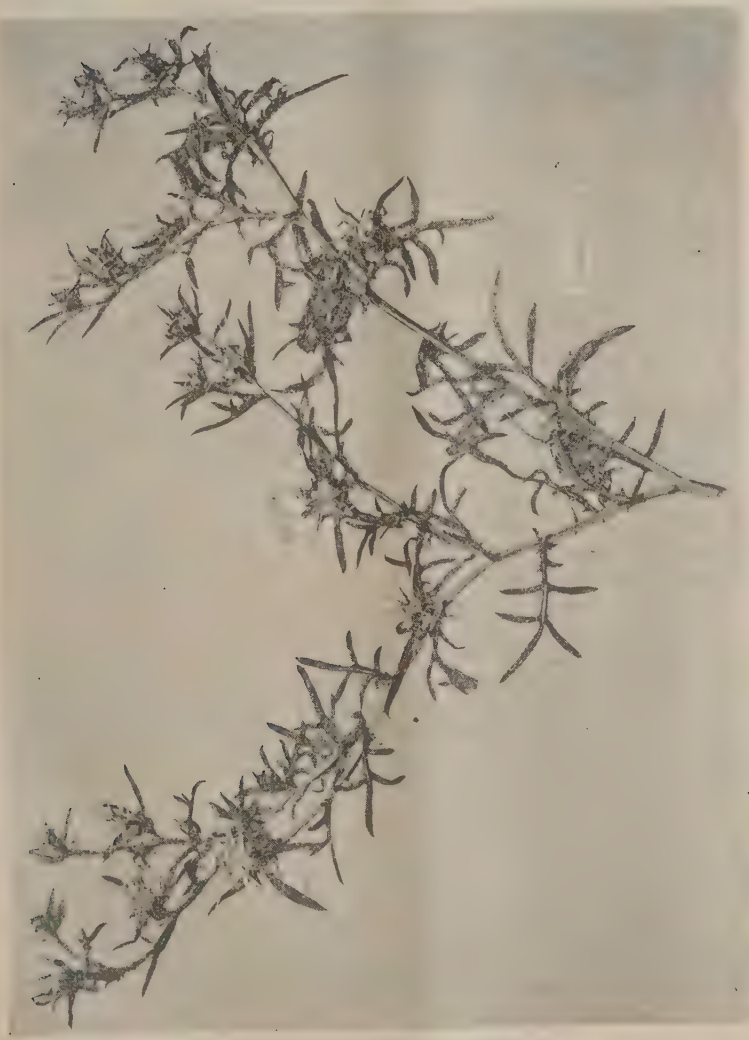


Plate 29.

Star Thistle.—Flowers lilac or pale purple; leaves dull green.

PLANT PROTECTION

Tomato Diseases and Their Control.

J. E. C. ABERDEEN (Formerly Pathologist, Science Branch).

(*Continued from page 25 of the July issue.*)

DISTRICT NOTES ON DISEASE INCIDENCE.

THERE are four main tomato growing areas in Queensland. Commencing from the north they are (1) Bowen, including the Burdekin delta to the north (2) Rockhampton, and south to Yarwun, (3) Brisbane (Metropolitan) and the Redlands area immediately south of Brisbane, and (4) Stanthorpe. The fifth area discussed in these notes, Innisfail, supplies a small local market and is included because of striking climatic and pathological differences rather than for its economic importance.

The range of disease and insect problems is very similar in each district but there is a distinct difference in the relative importance of the various diseases. Certain general principles govern the factors responsible for this variability.

Once a disease is present in a district, no matter to how small an extent, the two most important factors in its subsequent spread are temperature and moisture conditions. Figures 1 to 5 summarise the data on these two factors for each district. As regards temperature, the mean maximum and the mean minimum for each month have been graphed. For moisture conditions both relative humidity and rainfall have been included but the former is usually the more important in determining plant disease incidence. The growing season for tomatoes in each district is also indicated.

The relationship of the various diseases to temperature and moisture conditions is shown in Table 1. The grouping here is necessarily approximate but demonstrates the conditions necessary to initiate an epidemic. The disease once initiated may sometimes carry on into a season normally unfavourable. On the basis of this grouping lines have been drawn across the temperature graphs in the figures at 75 deg. F. and 60 deg. F. As a general guide to the influence of temperature on the incidence of the various diseases in the different districts it may be said that:—

(1) So long as the mean maximum temperatures are above 75 deg. F., those diseases favoured by high temperatures—for example, Fusarium wilt—must be regarded as possible dangers, the likelihood increasing as the mean maximum exceeds 75 deg. F.

(2) The one disease listed as being favoured by low temperatures (Irish blight) is very unlikely to occur when average minimum temperatures are greater than 60 deg. F. The farther

the minimum is below this figure, the greater the possibility. This standard is based principally on the incidence of the disease in the Brisbane–Redlands district.

(3) The third group of diseases, falling into the 60 deg.-75 deg. F. range, cannot be delimited quite as sharply as the previous two.

TABLE 1.

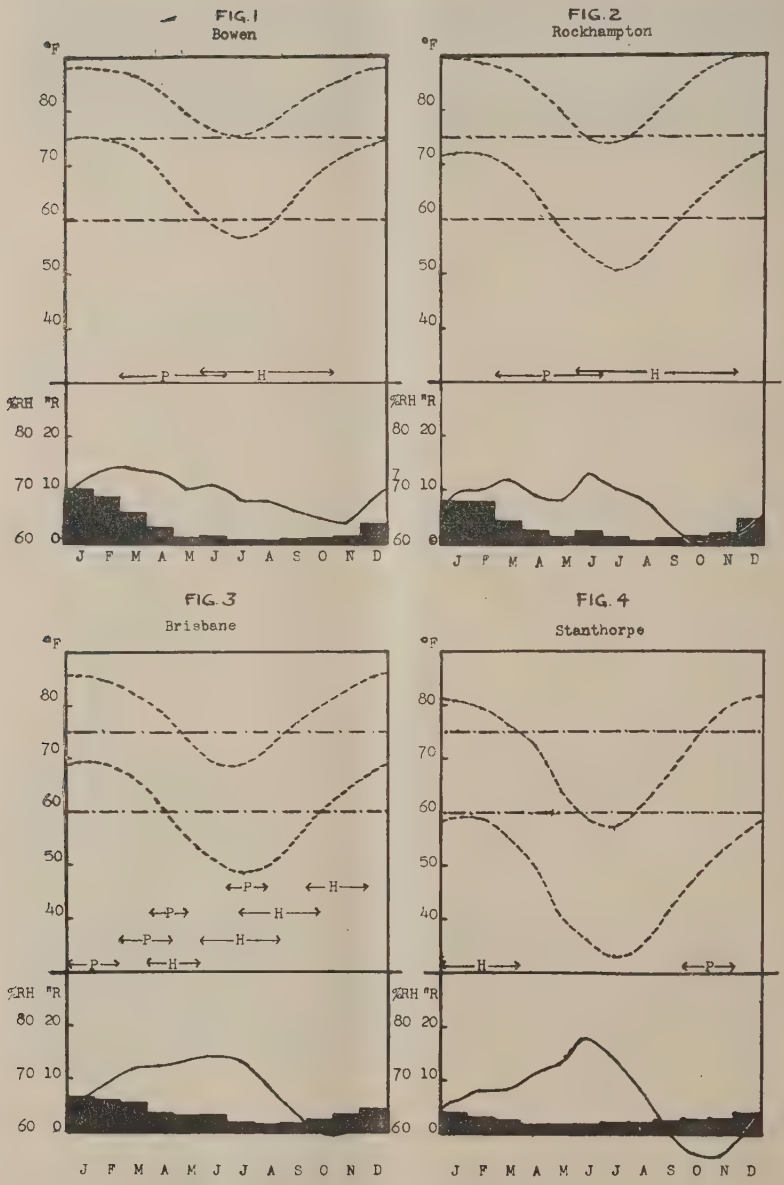
Classification of Diseases by their Temperature and Moisture Relationships.

Temperature.	Moisture Relationships.			
	Favoured by Dry Conditions.	Independent of Rainfall.	Favoured by Intermittent Showers and High Humidity.	Favoured by Continuous Rain or High Humidity.
High temperatures. Mean higher than 75° F.	Blossom end rot	Fusarium wilt Bacterial wilt		Leaf mould
Moderate temperatures. Mean 60–75° F.	Big bud ..	Verticillium wilt Spotted wilt	Target spot Septoria spot Bacterial spot Bacterial canker	Leaf mould Target spot Septoria spot Bacterial spot Bacterial canker
Low temperatures. Mean less than 60° F.				Irish Blight

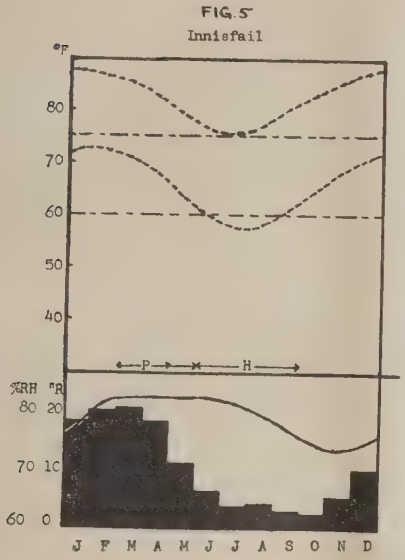
Bowen Area.

Tomato growing in the Bowen area is confined to the autumn, winter and early spring months. The plants are set into the field during the period March to May and the fruit comes on to the market in the months of June, July, and August. In the last few years this marketing period has been extended to September and early October by later plantings than above. From Figure 1 it will be seen that the growing period is characterised by low rainfall and low relative humidities. These conditions restrict the development of leaf diseases such as Irish blight, bacterial canker, bacterial spot, septoria leaf spot and target spot. Occurrence of the last-mentioned, however, is sufficiently likely to justify the use of copper in the dusts and sprays. The only outbreak of Irish blight in this area was a particularly severe one in 1927. In this case the rainfall for the months of June and July was 4·46 inches and 2·49 inches, respectively. The average for these months is 1·64 and 0·91 inches respectively.

Fusarium wilt and yellow mosaic are definitely of major importance. The local strains of tomato, generally known as Bowen Buckeye, are all very similar, and possess a high degree of resistance to Fusarium wilt. This variety has several marketing disadvantages and its replacement by better ones is desirable, but wilt resistance will need to be a major consideration in any trials carried out.



For explanation of figures, see opposite page.



Explanation of Figures 1-5.

°F (shown as dotted line)=mean maximum and mean minimum temperatures.

%RH (shown as unbroken line)=percentage relative humidity.

"R (shown blocked in black)=inches of rainfall.

P=period of planting seedlings into field.

H=period of harvesting.

Yellow mosaic is a difficult problem and control measures are all preventive ones. Though it is not proven by transmission tests there is little doubt that several of the common Solanaceous weeds are carriers. Big bud is commonly present but does not constitute a major problem.

To sum up the Bowen position, it may be said that insect pests (corn ear worm, jassids, and thrips) and mites cause the greatest loss in the local wilt-resistant variety at present grown, and the main emphasis in the sprays and dusts applied must be on the insecticide, a fungicide being added at the discretion of the grower or as advised.

Rockhampton-Yarwun.

The period over which tomatoes are grown in the Yarwun-Rockhampton area is a little longer than for Bowen, the fruit being marketed somewhat later, until the end of October.

Conditions here are a little more favourable to fungal and bacterial leaf diseases. Irish blight occurs very spasmodically, epidemics being very rare. Target spot is a constant trouble throughout and may be severe if the rainfall is above average. Fusarium wilt is present and the effect of the cooler winter temperature is still insufficiently low to justify planting of susceptible varieties. Those areas without irrigation suffer heavy losses from blossom end rot if the winter and spring rains are at all under average.

While more emphasis must be placed on fungicides than for Bowen, insect pests and tomato mites are probably still the major causes of losses. The regular use of a treatment combining insecticide and fungicide is recommended.

Brisbane-Redlands Area.

The Brisbane–Redlands area has the longest tomato-growing season of the four districts. Plantings into the field are made from January to July and fruit harvested in varying quantities from April to early December. There is some variation in the problems encountered, however, and for convenience of discussion this period will be divided into four—namely, autumn, winter, early spring, and spring crops. The descriptive term in each case indicates the period of the year that the crop comes on to the market, and has a fairly uniform interpretation among growers. The autumn and winter crops merge into each other, as might be expected, but the early spring and spring crops are fairly well delimited, as will be indicated in discussing their associated problems below.

Varieties used for planting out into the field in January and February must combine two qualifications—the maximum amount of resistance to Fusarium wilt and a good foliage cover for the fruit to prevent sunscald. Bacterial wilt also attacks this crop in many areas around Brisbane. While hardly affecting the tomato crop as a whole, this latter disease may entail complete loss to an individual grower. Bacterial spot is also prevalent in this crop following continued rains. Target spot is usually present and may also become prevalent, depending on rains. Irish blight may attack the tail end of this planting but is relatively rare. This autumn crop is a difficult one to grow in many districts but is economically worth while as the fruit comes on to the market as the Stanthorpe crop tails off.

If planting in March and April, the risk from Fusarium wilt is considerably reduced and varieties intermediate in resistance, such as Sioux, Salad's Special and Sunnybrook Earliana may be used. The light foliaged varieties such as Break o' Day may be planted with little fear of sunscald. Target spot and bacterial spot may still cause trouble but with the reduced rains this is less likely. Irish blight is still relatively rare, being controlled by reduced rainfall, though temperatures are often favourable.

While there is no sharp dividing line between the varieties used for the previous two plantings, the early spring crop requires varieties that are specialised in their ability to set fruit more freely during the cold weather of July and early August. Such varieties are mainly the small fruited cluster types, such as Salad's Special and Potentate, and a few of the Chinese types—for example, Rouge de Marmande. These are transplanted into the field during April. The disease situation is very similar to that described for the winter crop with the additional possibility of Verticillium wilt. Also, as the cluster varieties must be pruned and trellised to produce reasonably sized fruit, there is greater possibility of bacterial canker and mosaic being spread if originally present.

The main spring crop swings back to those varieties favoured for the winter crop and the seedlings are planted into the field during July. Except for differences brought about by the gradually rising temperatures, the disease problems are very similar. Fusarium wilt presents one important difference. Whereas varieties possessing little resistance may be successful in the winter crop, the main spring crop must be planted to one of the most resistant varieties. With the season advancing into the warm weather when the main crop is developing,

susceptible varieties will mature only the early hands before being overcome by wilt. Pruning and trellising are also practised for this spring crop in the Redlands district and this again adds to the risk of spreading bacterial canker and mosaic if these diseases are present.

It has been seen that leaf and fruit diseases are constantly present throughout these crops. Consequently the emphasis in the sprays and dusts must be placed on the fungicide. Also it is advisable to always include sulphur, as the tomato mite is widespread and its damage not recognised by many growers until too late. Insecticides will be required in the warmer parts of the year and particularly in the spring.

Stanthorpe Area.

In contrast to the three previous areas the Stanthorpe crop is a summer one, the young plants going into the field in October and November. It will be seen from Figure 4 that the relative humidity is very low for the early part of the season, with a consequent inhibition of the common bacterial and fungal leaf and stem diseases. However, target spot and Septoria leaf spot may cause considerable trouble during the latter half of the season and necessitate thorough treatment with a copper fungicide. Irish blight is rare and the few records available are for the month of April. Fusarium wilt is present but is relatively mild in its effect on the plant. Big bud occasionally infects a considerable proportion of the plants on individual farms.

The use of fungicides in this area is most important in the latter half of the crop. It may also be advisable occasionally to apply an insecticide both at this time and in the early part of the crop.

Innisfail Area.

The characteristic of this district is the very high rainfall and uniformly high humidity from March to July. Target spot is present and a source of loss but the most interesting feature is the epidemic development of leaf mould, which becomes a major problem. While this disease has been recorded in southern Queensland and on the Atherton Tableland, it is usually only on isolated plants in very protected positions. In other States it is only serious in glasshouses.

The combined insecticide and fungicide will be necessary in this area as the warmer climate is favourable to insect activity and the high rainfall conducive to the spread of fungal diseases.

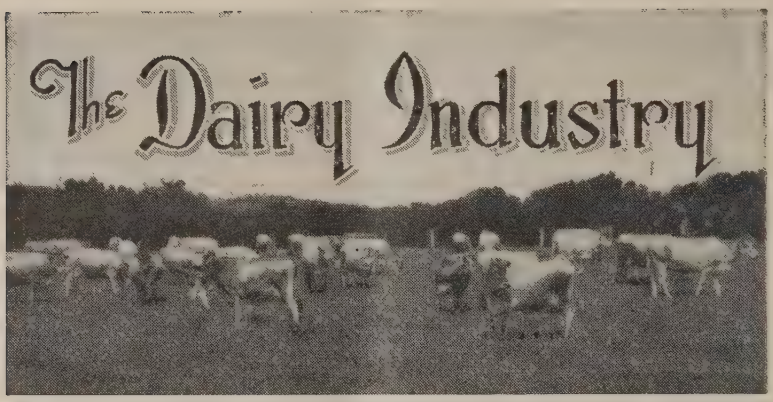
[TO BE CONTINUED.]

SEEDS AND CUTTINGS OF PASTURE PLANTS.

The Department of Agriculture and Stock often receives enquiries regarding supplies of cuttings of grasses such as Kikuyu, elephant and Para (also known as panicum muticum or giant couch).

Seeds of various grasses and pasture legumes which are usually in short supply are also frequently sought. These seeds include green panic and other Guinea grasses, blue panic, buffel grass, and the so-called "Townsville lucerne."

Farmers and others handling such planting material are requested to inform the Department so that enquiries can be directed to any local sources of supply. Seeds offered for sale must, however, comply with certain conditions, particulars of which are obtainable on application.



The Determination of Water in Butter.

Prepared in the Division of Dairying.

THE method used for the determination of water in butter—commonly known as the moisture test—may be summarised as follows:—

> A known weight of butter in a weighed metal dish is heated until all water is expelled as steam. The dish and its contents are then cooled to atmospheric temperature and again weighed. The loss in weight is the water in the particular weight of butter taken and the percentage may be calculated by simple proportion.

There are quite a number of modifications in technique, mainly due to various types of balances, but the principles of the test remain the same.

The equipment required is—

1. Balance and necessary weights.
2. Metal cup.
3. Spatulas to transfer butter to the cup.
4. Heater.
5. Tongs for handling the hot cup.
6. Cooling bath.
7. A number of clean dry cloths.

Facilities and Precautions.

A balance sensitive to at least 0·01 ($\frac{1}{100}$) gram is necessary for accurate moisture tests. It is an instrument of precision and should be treated as such. It must not be placed in a position exposed to air currents, as accurate tests would be impossible under those conditions. Splashing water, steam, heat radiations and poor lighting are other factors which must be guarded against.

SMALL LABORATORY FOR A BUTTER FACTORY.

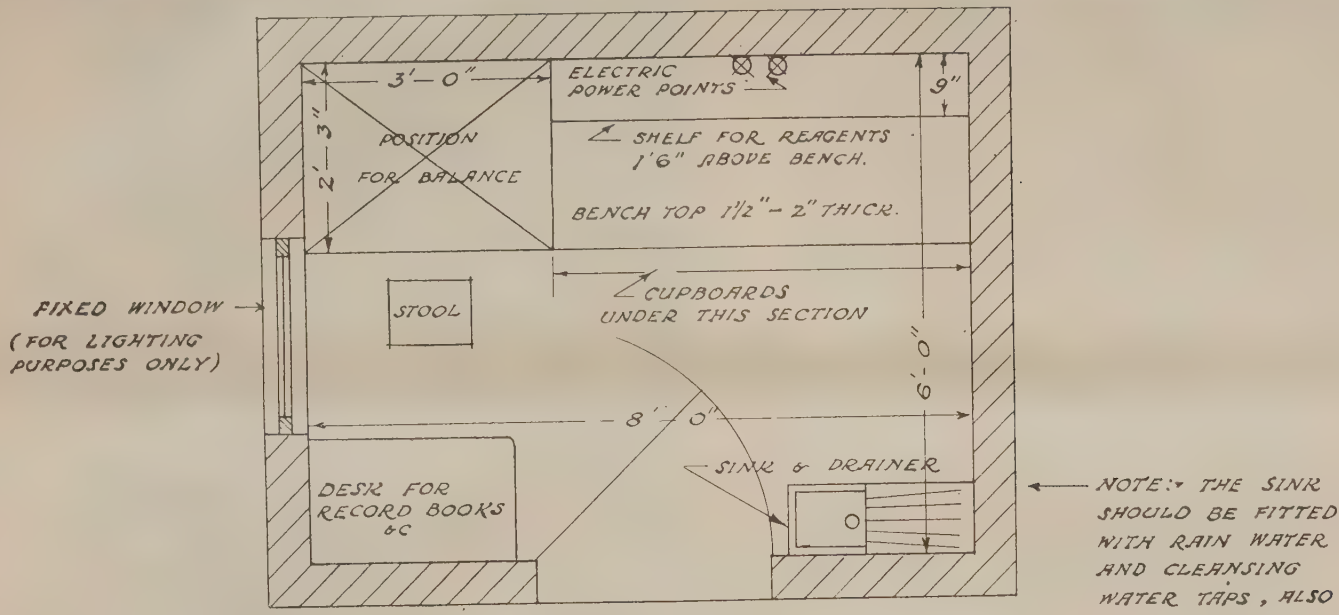

3'—0"
2'—3"
POSITION FOR BALANCE
ELECTRIC POWER POINTS
9"
SHELF FOR REAGENTS 1'6" ABOVE BENCH.
BENCH TOP 1½"—2" THICK.
FIXED WINDOW (FOR LIGHTING PURPOSES ONLY)
STOOL
CUPBOARDS UNDER THIS SECTION
2'—6"
8'—0"
SINK & DRAINER
DESK FOR RECORD BOOKS &C
NOTE:- THE SINK SHOULD BE FITTED WITH RAIN WATER AND CLEANSING WATER TAPS, ALSO STEAM JET INTO SINK.
PLAN
SCALE OF FEET.
1 0 1 2 3 4 5 6 7 8

Plate 30.

The bench or shelf on which the balance stands must be level and absolutely rigid so that vibrations from machinery, &c., do not interfere with the balance. So important are accurate moisture tests that a small laboratory or test room should be built as an integral part of every butter factory in which real efficiency is desired. This room, which for chemical tests need be only about 8 ft. by 6 ft., must be quite distinct from the room in which the fat tests are performed and close to the churning room. The size suggested offers ample bench space for moisture, salt and acidity tests which the butter-maker may desire to perform from time to time. A plan of such a laboratory is shown in Plate 30. Even in a room such as this, the balance should be protected from dust and chance currents of air by a case, preferably with a sliding glass door at the front.

The type of heater used in most factories is a spirit lamp. This certainly serves the purpose, but it has the great disadvantage that the bottom of the cup becomes covered with a deposit of carbon and the weight of the cup is thereby altered. As most factories generate electricity, the spirit lamps in such cases should be replaced by a suitable electric heater, which is clean and equally rapid. Suitable types are shown in Plate 31. The adapted electric radiator has a heating element of about 500 watts and the hot plate is of the three-heat type. Spare heating elements should be kept on hand for emergencies and only require to be screwed into place. Whatever type of heater is used, it should be placed *outside* the balance case and at least 1 foot away.

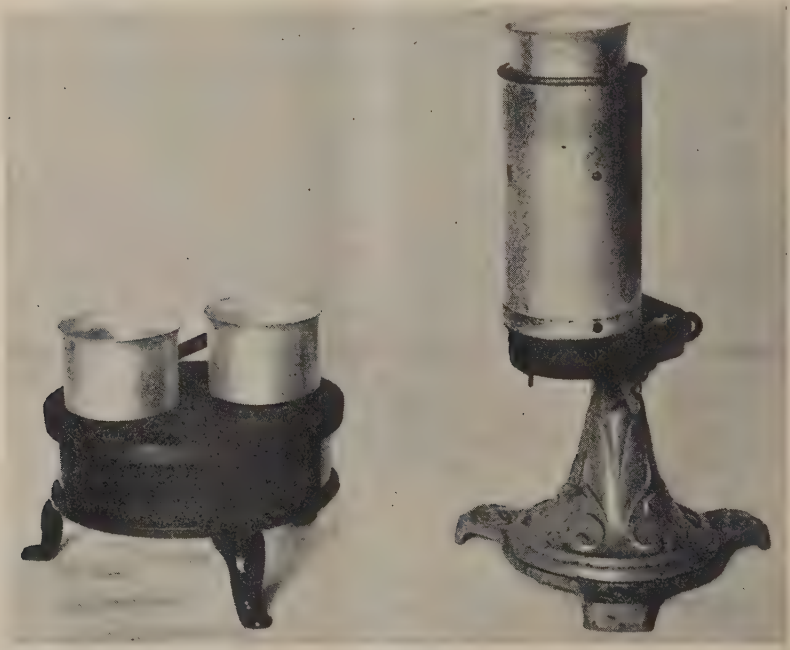


Plate 31.

ELECTRIC HEATERS.—Left—Three-heat hot plate. Right—Adapted electric radiator.

Another important piece of equipment is a cooling bath in which the hot dish may be rapidly cooled to atmospheric temperature. A dish of cold water is very satisfactory for this purpose. A supply of clean, dry cloths must be available, as the dish must be wiped perfectly dry before being placed on the balance. *The dish must never be placed on the balance whilst hot,* as the heat transferred to one side of the balance immediately puts the balance out of adjustment and an inaccurate weighing or reading results, which may be perpetuated in following tests. The practice of making "hot weighings" is probably the principal cause of inaccurate factory tests.

Weights should never be handled with the fingers, but always with a small pair of forceps. The balance should always be brought to rest before adding weights or altering their position, as rough treatment will quickly wear away the sharp knife edges of the balance and destroy its sensitivity.

The remainder of the equipment requires little discussion. The metal cup is usually of aluminium, which is quite suitable for the purpose. Spatulas for the addition of butter to the dish should be of bone or some non-scratching material. One spatula should be ground to a fine point to facilitate the final adjustment. Tongs for handling the hot cup may be of either the ordinary hand type or the spring type.

Taking the Sample.

In all chemical work the most important part of the process is the taking of the sample. One of the first axioms of the analyst is "*An analysis is only as accurate as the sample,*" and a sample must therefore be as representative of the whole as is possible. Butter from one end of the churn has not necessarily the same composition as butter from the centre or the other end, and *at least three portions of butter from various positions in the churn must be taken* to obtain a representative sample. In taking these portions the exposed surface of the butter, with its adhering free moisture, must be removed before the portion is taken by using a spatula or trier.

Having obtained a representative sample this must be mixed thoroughly so that the analysis may be carried out in duplicate, if required, with the same result. There are several ways of preparing the sample, the main methods being—

(*a*) Place the butter in a dry glass jar with a tight-fitting lid, and place the jar in warm water at a temperature of about 100 degrees Fahr. until it is thoroughly softened and may be mixed, by shaking, into a homogeneous creamy mass. If this method is used care should be taken to see that no unmelted lumps of butter remain. It is equally important not to overheat the sample, as this causes a separation of the serum from the fat, and in this condition it is almost impossible to obtain a representative sample.

(*b*) Place the portions of butter on a slab of glass, or a glazed tile, about 6 to 8 inches square, and quickly and thoroughly mix with a bone spatula. A wide-mouthed cup of china or metal will be equally serviceable, but a narrow-mouthed vessel should be avoided, as it is difficult to mix the sample in a vessel of this type.

For factory use the latter method is recommended, as it is much quicker and the very small amount of moisture lost by evaporation during the mixing is not sufficient to cause a noticeable error.

The weighing of the ten grams of butter should be carried out immediately after the sample is prepared. If it is not convenient to weigh immediately, the sample should be placed in a glass jar with a tight-fitting lid and mixed just prior to weighing.

Correct Method of Weighing.

With all balances, except the Avery balance, the weighing should be performed by allowing the balance to swing freely and noting the number of divisions reached by the pointer on each side of the centre line of the scale. When the balance is in equilibrium the pointer swings the same number of divisions on each side. *Do not accept a weighing in which the pointer remains stationary*, as the beam or pointer may be stuck.

The various techniques to be followed when using the better known types of balance are given in the following sections.

The Physical Balance.

The physical balance is one which can be used for many other purposes than the determination of water in butter. It can be used for general analytical purposes where extreme accuracy is not required, because a good physical balance may be sensitive to 0·001 ($\frac{1}{1000}$) gram. The balance shown in Plate 32 is the cheapest type, and requires a set of weights down to 0·01 gram.

Two methods may be used with this type of balance—

1. (*a*) See that the pointer swings an equal number of scale divisions on each side of the centre line with the pans empty.

   (*b*) Weigh the clean dry cup as accurately as possible by placing the cup on the left pan and the weights on the right pan.

   (*c*) Add ten grams to the weights already on the right pan and record the total weight (A).

   (*d*) Place butter from the well mixed sample into the cup until the balance is again in equilibrium.

   (*e*) Place the cup over the heater and shake gently during the evaporation of the water to prevent spurting. During the final stage, the butter froths up in the cup, then subsides, and the fat may be seen boiling quietly. The colour will then be a light brown.

   (*f*) Remove the cup from the heater and cool to atmospheric temperature in the cooling bath.

   (*g*) Wipe the outside of the dish perfectly dry and replace on the left pan of the balance.

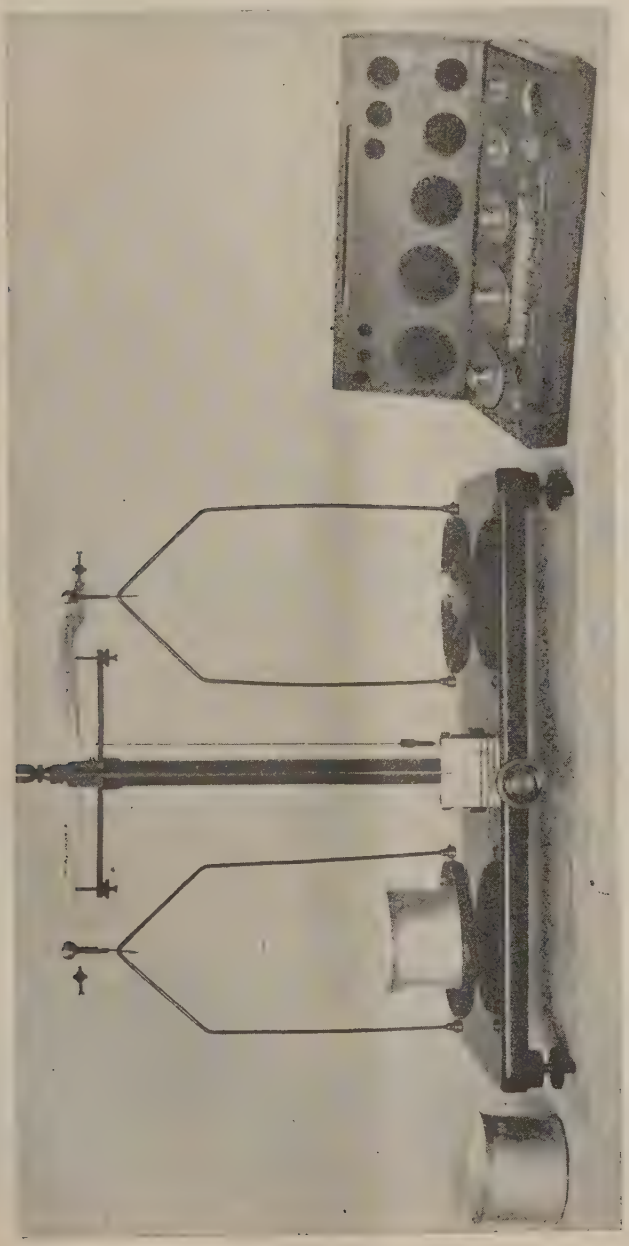


Plate 32.
The physical balance with set of weights and metal cups.

(*h*) Weigh again as accurately as possible and record the weight (B). Subtract the second weight (B) from the first weight (A). The difference is the weight of water in the ten grams of butter taken.

Percentage of water = (A—B) $\times \frac{100}{10}$
= (A—B) $\times$ 10

Example—

1st weight (A)	=	38·54 grams
2nd weight (B)	=	37·02 grams
Difference (A—B)	=	1·52 grams
Percentage of water	=	1·52 $\times$ 10
	=	15·2

2. The second method eliminates the use of a number of weights, the determination being performed by the use of a 10 gram, a 1 gram and the eight fractional weights from 0.5 down to 0.01 gram. Prepare a counterpoise from a piece of lead, brass, or copper to weigh exactly the same as the clean dry cup. If there are two or more cups available, a counterpoise for each may be made so that a number of tests may be performed at the same time. Then proceed as follows:—

(*a*) See that the pointer swings an even number of scale divisions on either side of the centre line with the pans empty.

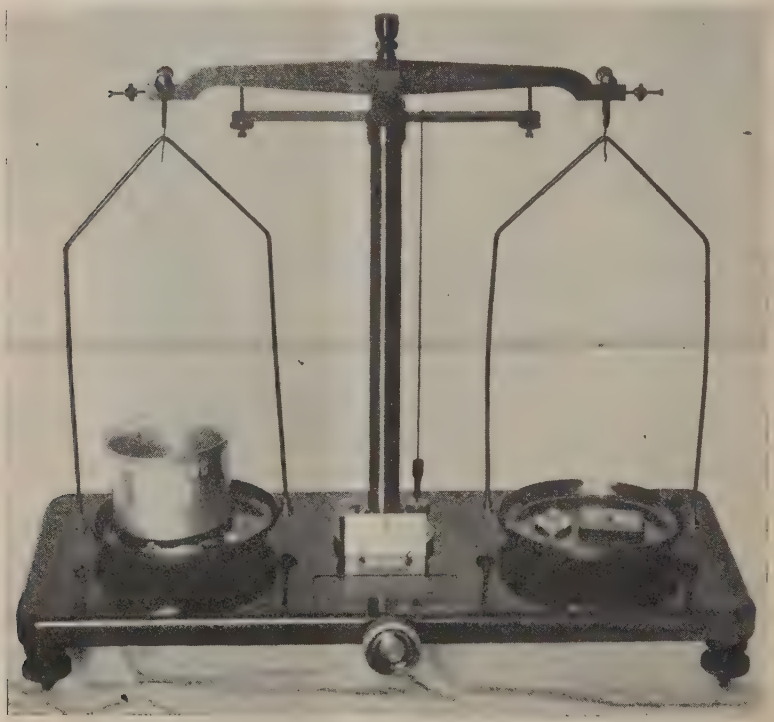


Plate 33.

The physical balance with cup, counterpoise and weights in position. The sum of the weights on the left pan is 1.57 grams, indicating 15.7 per cent. of water.

(*b*) Place the clean dry cup on the left pan and the corresponding counterpoise on the right pan and see that the balance swings evenly. If not, adjust the counterpoise to the correct weight.

(*c*) Place a 10 gram weight on the right pan with the counterpoise.

(*d*) Place butter from the well-mixed sample into the cup until the balance is again in equilibrium.

(*e*) Place the cup on the heater and shake gently during the evaporation of the water to prevent spurting. During the final stage the butter froths up in the cup, then subsides, and the fat may be seen boiling quietly. The colour will then be a light brown.

(*f*) Remove the cup from the heater and cool to atmospheric temperature in the cooling bath.

(*g*) Wipe the outside of the cup perfectly dry and replace on the left pan of the balance.

(*h*) Leave the 10 gram weight on the right pan and add small weights to the *left* pan until the balance is again in equilibrium. The sum of the small weights added (C) is the weight of the water which was evaporated from the 10 grams of butter.

Plate 33 shows the balance with the cup, counterpoise, and weights in place.

$$\text{Percentage of water} = C \times \frac{100}{10}$$
$$= C \times 10$$

Example.—1·57 grams were added to the left pan.

$$\text{Percentage of water} = 1{\cdot}57 \times 10$$
$$= 15{\cdot}7$$

Physical Balance with Attached Rider.

A more satisfactory type of physical balance is that shown in Plates 34 and 35. A rider attached to the beam of this balance eliminates the use of weights smaller than 1 gram. This balance is adjusted with the rider on the O mark on the extreme left of the beam. The techniques of the two methods given above require a little modification when using this balance.

1. (*a*) See that the pointer swings an even number of scale divisions on each side of the centre line with the pans empty and the rider on the 0 mark of the beam.

(*b*) Weigh the clean dry cup by placing the cup on the left pan and weights down to 1 gram on the right pan until an extra 1 gram makes the weight too heavy. Then slide the rider along the beam until equilibrium is attained.

Example.—If the cup weighs 28·28 grams, 28 grams would be placed on the right pan (29 grams would be too heavy) and the rider slid along the beam to the 0·28 mark showing a total of 28·28 grams. (See Plate 34.)

(*c*) Leaving the rider in the same position, add 10 grams to the weights on the right pan and record the total weight (A).

Example.—28·28 + 10 = 38·28 (A).

(*d*) Place butter from the well mixed sample into the cup until the balance is again in equilibrium.

(*e*) Place the cup on the heater and shake gently during the evaporation of the water to prevent spurting. During the final stage the butter froths up in the cup, then subsides, and the fat may be seen boiling quietly. The colour will then be a light brown.

(*f*) Remove the cup from the heater and cool to atmospheric temperature in the cooling bath.

(*g*) Wipe the outside of the cup perfectly dry and replace on the left pan of the balance.

(*h*) Weigh again as described in (*b*) above, and record the weight (B). Subtract the second weight (B) from the first weight (A). The difference is the weight of water in the 10 grams of butter and the percentage is obtained by multiplying the difference in weight by 10.

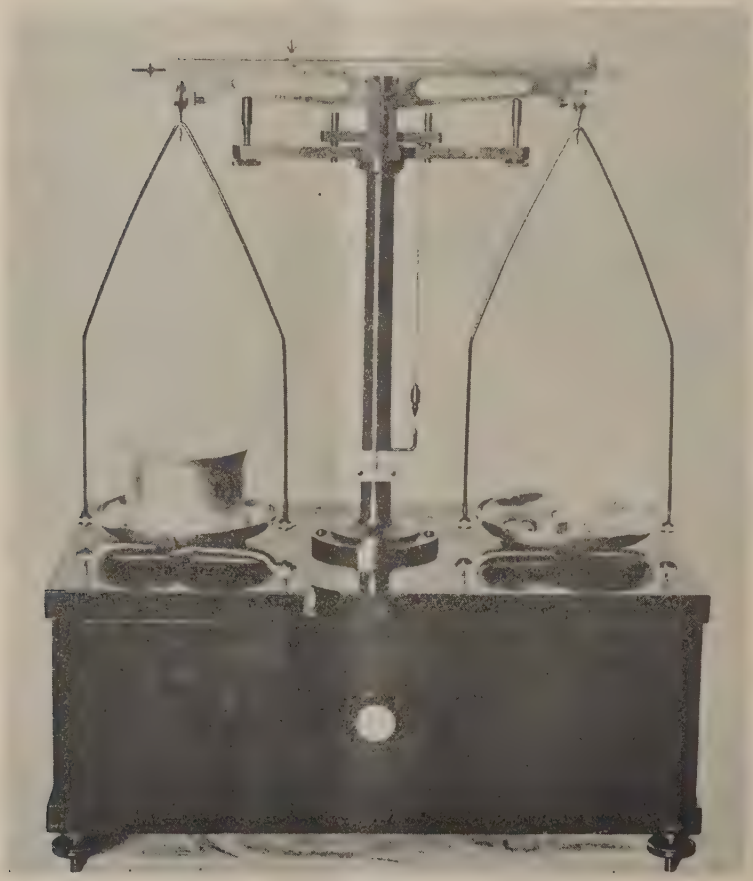


Plate 34.

The physical balance with attached rider showing a weight of 28.28 grams. Note that weights smaller than 1 gram are not required. The rider is indicated by an arrow.

Example.—

1st weight (A)	=	38·28 grams.
2nd weight (B)	=	36·72 grams.
Difference (A—B) ..	=	1·56 grams.
Percentage of water ..	=	1·56 × 10.
	=	15·6

2. Prepare a counterpoise for the cup as described previously.

(*a*) See that the pointer swings an even number of scale divisions on each side of the centre line with the pans empty and the rider on the 0 mark of the beam.

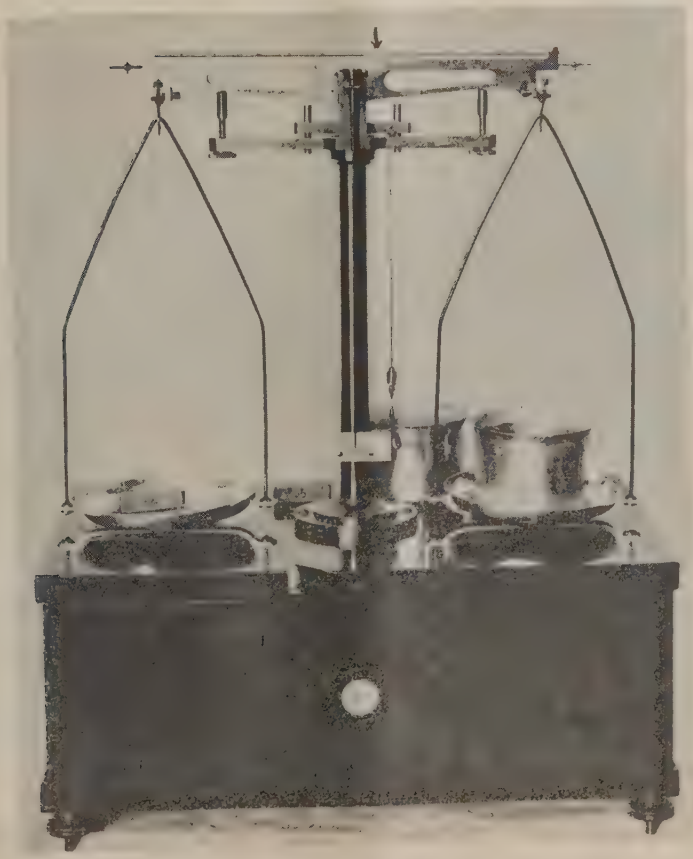


Plate 35.

Physical Balance with Attached Rider.—The cup, counterpoise, and weights are in position, and the rider is on the 0.57 gram mark, indicating 15.7 per cent. of water.

(*b*) Place the clean dry cup on the *right* pan (note the change from the usual left pan) and the corresponding counterpoise on the left pan, and see that the balance is in equilibrium. If not, adjust the counterpoise to the correct weight.

(*c*) Place a 10 gram weight on the left pan with the counterpoise.

(*d*) Place butter from the well mixed sample into the cup until the balance is again in equilibrium.

(*e*) Place the cup on the heater and shake gently during the evaporation of the water to prevent spurting. During the final stage the butter froths up in the cup, then subsides, and the fat may be seen boiling quietly. The colour will then be a light brown.

(*f*) Remove the cup from the heater and cool to atmospheric temperature in the cooling bath.

(*g*) Wipe the outside of the cup perfectly dry and replace on the left pan of the balance.

(*h*) Leave the 10 gram weight on the left pan, place a 1 gram weight on the right pan and slide the rider along the beam until the balance is in equilibrium. The weight of water in 10 grams of the butter amounts to 1 gram plus the fraction of a gram shown by the rider. This sum is recorded as C.

$$\text{Percentage of water} = C \times 10.$$

Example.—Plate 35 shows the balance with the cup and 1 gram weight on the right pan, the counterpoise and the 10 gram weight on the left pan, and the rider on the 0·57 gram mark.

Weight of water in 10 grams of butter $= 1 \text{ gram} + 0{\cdot}57 \text{ gram} = 1{\cdot}57 \text{ grams.}$

Percentage of water $= 1{\cdot}57 \times 10.$

$= 15{\cdot}7.$

By following this technique the position of the rider will give what almost amounts to a direct percentage reading—i.e., the rider on the 0·57 gram mark denotes 15·7 per cent., the 0·5 and 0·6 gram marks denote 15·0 and 16·0 per cent. respectively, and so on. For this reason, and because of its sensitivity and general utility, this type of balance is strongly recommended for use in a control laboratory or wherever reliable and accurate tests are required.

The Torsion Balance.

The torsion balance, illustrated in Plates 36 and 37 is a robust, reliable balance specially designed for the determination of water in butter. With a set of weights it can also be used for other work where an accuracy of less than 0·01 gram is not required. The balance has four beams fitted with non-detachable riders. One beam is fitted with a large tare or counterpoise weight (A) with which the metal cup can be roughly counterpoised. Another graduated beam has attached to it a small tare weight (B) with which the final counterpoising of the cup is performed. Two beams, each having an attached rider, are graduated in percentages, the larger (D) being from 0 to 20 per cent. in 0·2 divisions and the

smaller (C) being from 0 to 10 per cent. in 0·1 divisions. The balance is used as follows:—

(*a*) Place the percentage riders (C and D) on their respective zero marks (the left side of the rider coinciding with the 0 line at the left side of the scales), the small tare weight (B) on the zero mark in the centre of the scale, and the large tare weight (A) as far to the right of its beam as it will go. Level the balance by adjusting the levelling screws so that the pointer swings an even number of scale divisions on each side of the centre line. Do not again touch the levelling screws.

(*b*) Place the cup on the right pan. Roughly counterpoise it by sliding the large tare weight (A) to the left and screwing it in place and then counterpoise it accurately by sliding the small tare weight (B) to the right or left as required. When a number of tests are being made a number of cups of approximately the same weight (within a range of 0·5 gram) are required, and the exact position of the small tare weight (B) for each cup should be noted.

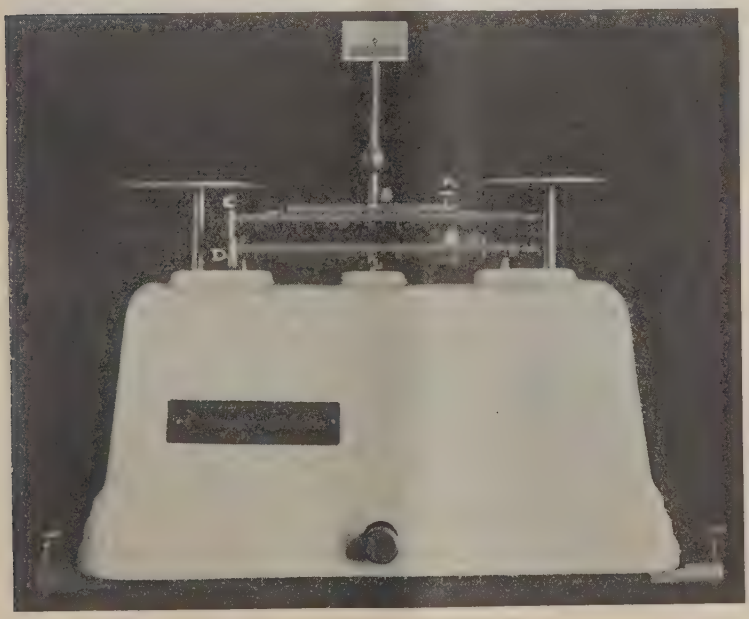


Plate 36.

The Torsion Balance.—A. Large tare weight. B. Small tare weight. C. Smaller percentage rider on the 0 to 10 per cent. scale. D. Larger percentage rider on the 0 to 20 per cent. scale.

(*c*) Place the 10 gram weight on the left pan.

(*d*) Place butter from the well mixed sample into the cup until the balance is again in equilibrium.

(*e*) Place the cup on the heater and shake gently during the evaporation of the water to prevent spurting. During the final stage the butter froths up in the cup, then subsides, and the fat may be seen boiling quietly. The colour will then be a light brown.

(*f*) Remove the cup from the heater and cool to atmospheric temperature in the cooling bath.

(*g*) Wipe the outside of the cup perfectly dry and replace on the right pan of the balance.

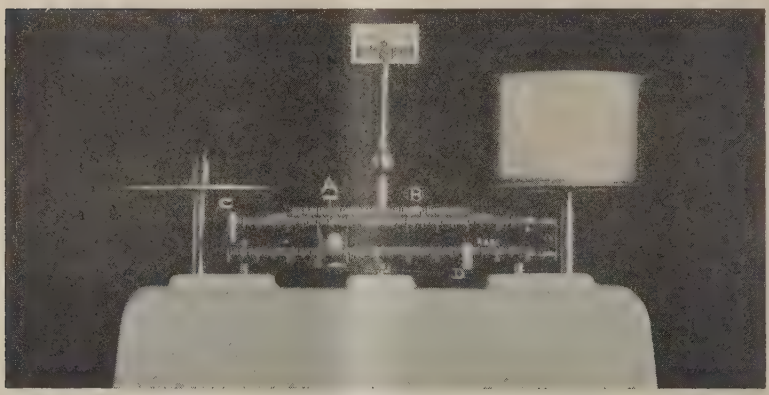


Plate 37.

Beams of the Torsion Balance.—Note the altered positions of the tare weights A and B. The larger percentage rider D indicates 15.6 per cent. of water.

(*h*) Leave the 10 gram weight on the left pan and slide the larger percentage rider (D) along its scale to the right until the balance is again in equilibrium. The percentage of water in the butter is obtained by taking the reading on the scale corresponding to the left-hand side of the rider. If desired, this rider may be slid along to the 10 per cent. or other mark and the smaller rider (C) used to obtain the final reading, in which case the two readings must be added together. When a number of tests are made together, the small tare weight (B) must be replaced in the correct position for each cup as determined in (*b*) above.

Example.—Plate 37 shows a close-up view of the scales showing a reading of 15·6 per cent. using the larger rider (D) only.

The One-pan Balance.

This type of balance is a one-purpose balance as it can only be used for the determination of water in butter. It also has a number of other disadvantages when compared with the physical and torsion balances, not least amongst them being the loose weights of a special design which can only be handled with the fingers, no forceps being provided with the balance. Another disadvantage is that only one test at a time can

be performed unless a number of cups of *exactly* the same weight are available. Fairly reliable results are obtainable if the balance is kept clean and the cup and weights handled only with clean dry hands. A typical balance of this type is illustrated in Plate 38. The weights supplied with the balance are a 10 gram hooked weight, a 2 gram rider, and a 0·2 gram rider. Working directions are as follows:—

(*a*) Place the clean dry cup on the pan.

(*b*) Suspend the 10 gram weight from the hook above the pan, allow the balance to swing and adjust, by means of the screw on the right of the beam, until the balance pointer swings the same number of scale divisions on each side of the centre line.

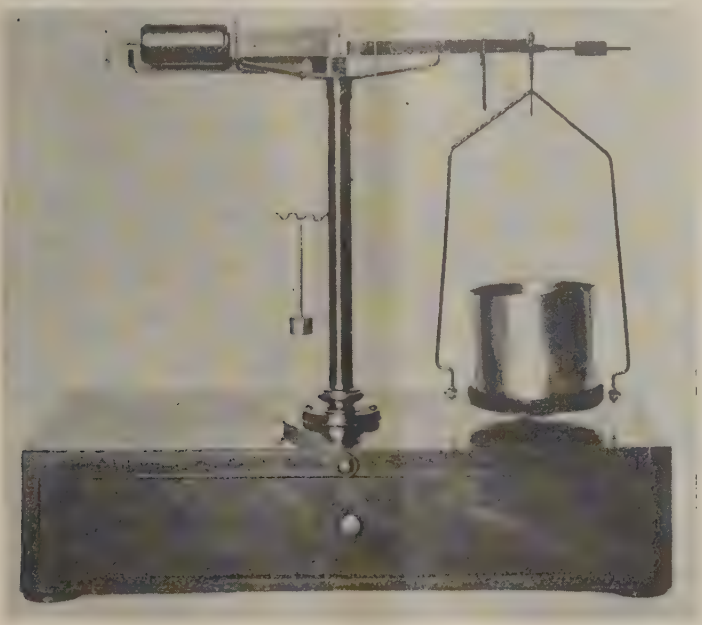


Plate 38.
The One-pan Balance.—The riders show 15.4 per cent.

(*c*) Remove the 10 gram weight.

(*d*) Place butter from the well mixed sample in the cup until the balance is again in equilibrium.

(*e*) Place the cup on the heater and shake gently during the evaporation of the water to prevent spurting. During the final stage the butter froths up in the cup, then subsides, and the fat may be seen boiling quietly. The colour will then be a light brown.

(*f*) Remove the cup from the heater and cool to atmospheric temperature in the cooling bath.

(*g*) Wipe the outside of the cup perfectly dry and replace on the balance pan.

Plate 39.
The Avery Balance.

(*h*) Place the 2 gram rider on one of the percentage marks on the graduated beam, taking care that the rider is seated properly in the groove and does not touch the beam supports. If necessary, alter the position of the rider until the percentage mark lower than the true percentage is found. Then place the 0·2 gram rider on the beam in the various grooves until the balance is again in equilibrium. The percentage is obtained by noting the positions of the riders, the larger giving the whole per cent. and the smaller giving the tenths of 1 per cent.

Example.—In Plate 38 the larger rider is on the 15 per cent. mark and the smaller rider is on the 4 per cent. mark. The butter would contain 15·4 per cent. of water.

The Avery Balance.

A comparatively recent introduction is the Avery oil damped balance in which the pointer is rapidly brought to a stationary position by means of a paddle immersed in an oil bath. It is a one-purpose balance capable of being used only for the determination of water in butter. A compensating weight enables any quantity of butter between 8 and 12 grams to be taken and the percentage of water is obtained direct from the scale. It has a serious disadvantage for butter standardisation purposes, as no salt test can be performed unless the exact weight of butter taken is known. To weigh out a definite quantity of butter on this balance requires a radical modification of technique, as the balance is designed to make such a weighing unnecessary. If more than one test is to be performed, a number of cups of *exactly* the same weight are required. Constant skilled attention is required to obtain consistently accurate results. The balance is supplied with a 12 gram weight for adjustment purposes. The balance is used as follows:—

(*a*) Screw down the compensating weight as far as it will go. Plate 39 shows the correct position. Do not shift the lock nut under any circumstances.

(*b*) Place the clean dry cup and the 12 gram weight on the pan. The pointer should come to rest exactly on the 0 mark on the right of the scale. If not, adjust to the 0 mark by rotating the screw behind the bar with a turn screw, clockwise or anti-clockwise as required.

(*c*) Remove the 12 gram weight.

(*d*) By means of the butter sampler take a portion of the well mixed sample and place in the cup. Alter the position of the compensating weight until the pointer again rests on the 0 mark.

(*e*) Place the cup on the heater and shake gently during the evaporation of the water to prevent spurting. During the final stage the butter froths up in the cup, then subsides, and the fat may be seen boiling quietly. The colour will then be a light brown.

(*f*) Remove the cup from the heater and cool to atmospheric temperature in the cooling bath.

(*g*) Wipe the outside of the cup perfectly dry and replace on the balance pan.

(*h*) Read off the percentage of water from the scale.

Performing the Mules Operation on Fully Grown Sheep.

G. R. MOULE, Officer in Charge, Sheep and Wool Branch, and HAROLD POPE, Senior Adviser in Sheep and Wool.

IT is usually agreed that the ideal time at which to perform the Mules operation on sheep in Queensland is between 5 and 10 months of age, provided that black bush flies and blowflies are not active. This means that each year's drop of lambs are usually treated immediately after their first shearing and in a few years, as older sheep are cast for age, the flock becomes composed entirely of Mules treated sheep.

Advantages of Early Treatment.

The advantages of treating sheep between 5 and 10 months of age are accepted as being:—

(1) Young sheep are the most susceptible to fly strike and the early application of the Mules operation affords them protection for the maximum time and during the greatest danger period.

(2) Young sheep are lighter to handle and require less restraint.

(3) The operation need not be so radical as when performed at lamb marking, when unmothering may be an important cause of loss.

Operating on Older Sheep.

The extremely good results which have followed the application of the Mules operation to young sheep have led some woolgrowers to treat older animals. This can be done quite satisfactorily provided reasonable methods of restraint are available which will minimise the heavy work associated with catching, lifting and holding the sheep.

One device which has proved eminently satisfactory in the Maranoa during the past two years is a modification of the Bundy crush, which is used quite commonly in New South Wales. It consists of a vertical

opening in a panel of fencing around a small pen on a raised grating floor, which should be about level with the operator's belt. The opening should be between 20 and 24 inches wide and should run up the full length of the fence. A wooden or iron bar is placed horizontally across the opening about 12 inches from the grating floor. It should be possible for the operator, who stands on the ground and faces the opening, to remove the horizontal bar easily or to swing it back out of the way. He should be able to move the bar with his left hand and it should be fixed quite firmly when in position. The hinged bar shown in Plate 41 is preferable to the pull-through pin shown in Plate 40.

In Plate 40, a sheep is shown in position between the uprights which border the opening in the walls of the pen. The animal is caught by the muzzle and thrown in the same way as a shearer handles sheep which he is taking out of the catching pen. The hindquarters are then swung under the horizontal rail, so that the hocks are caught in the position shown in the illustration.

Plate 40.

DEVICE FOR HOLDING SHEEP FOR MULES OPERATION.

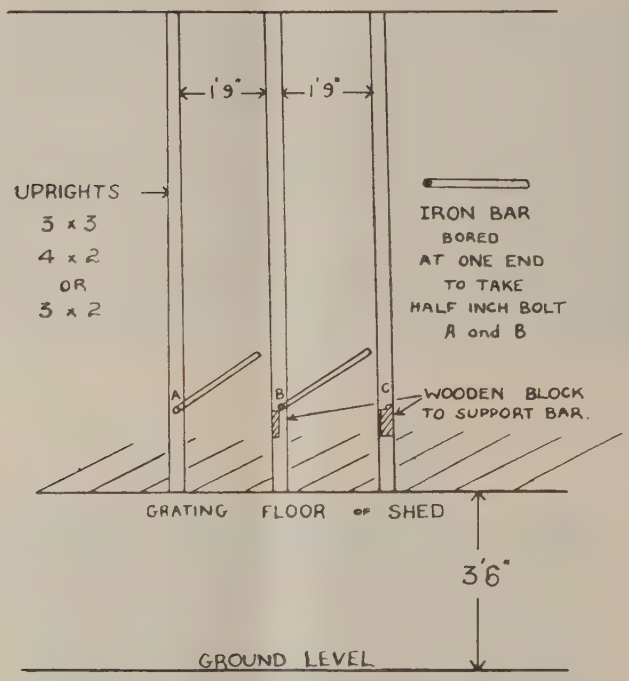


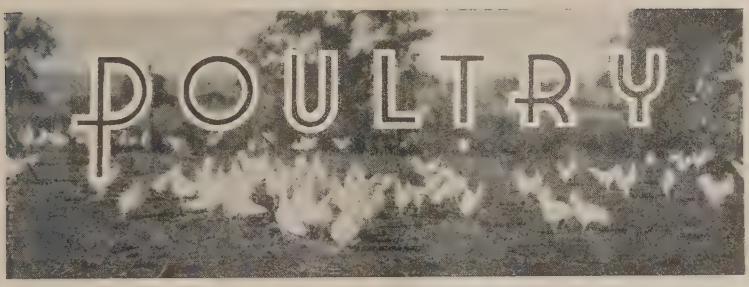
Plate 41.
Sketch of Alternative Device to that Shown in Plate 40.

The breech of the sheep projects out towards the operator and the catcher stands with the animal's back and head resting against his legs. If necessary, he can lean over and hold the sheep's hocks against the bar.

As soon as the operation is completed the operator releases the horizontal bar and the catcher allows the sheep to fall forward on its feet and then returns the bar to its horizontal position before catching another sheep. With two catchers, each with an opening and bar, one experienced operator can treat 650 to 800 adult sheep comfortably in a day and the catchers do not show signs of fatigue.

Restraint of this type can be used for young sheep, but it is of particular benefit when adult animals are to be treated, as it obviates the heavy work usually associated with applying the Mules operation to sheep of this class.

The performance of the actual operation and the after-treatment of the sheep are similar to those with which most experienced operators are familiar. If any details of this treatment are required, wool-growers should contact the nearest field officer of the Sheep and Wool Branch.



Poultry Nutrition: Principles and Practices.

P. RUMBALL, Officer in Charge, Poultry Branch, and F. N. J. MILNE, Assistant Husbandry Officer (Poultry).

(*Continued from page* 38 *of July issue.*)

CARE OF THE MOULTING HEN.

IT is a common practice among breeders to give little attention to moulting birds. In many instances they receive nothing but a grain ration. Feathers contain a considerable amount of protein, and the most economical manner of getting birds back into production is to feed protein-rich foods as provided in a laying ration. Moulting may be induced by the feeding of nothing but grain at or about the time birds usually moult. When once the moult has commenced laying rations should be supplied, as it will take about a fortnight for the manufacture of the first egg after the moult is completed.

FATTENING.

Two classes of birds have to be considered—old hens and cockerels. The ability of the feeder to do much with old hens in good condition is questionable, but those slightly out of condition may be improved with 10 to 14 days' crate feeding. From experiments it has been found economical to rear cockerels to the various marketing stages on the growing rations used for pullets. Ten to 14 days of crate feeding for these birds would undoubtedly add to their market value. Old hens or young cockerels should be freed of external and internal parasites before being submitted to a fattening process. The crates could be small coops 2 feet wide, 3 feet deep, and 3 feet high. These crates hold about six birds, and if the floor is of wire-netting and above ground level the droppings will fall through and the birds will be kept clean. The front should be of wire or slats wide enough apart for the birds to get their heads through to feed from a trough in the front. An all-mash mixture of a relatively high protein content fed as a gruel three times a day will undoubtedly improve condition. With this system of feeding water is not necessary. Any food remaining after half-an hour should be removed in order to keep the appetite keen. A mash of equal parts maize meal and pollard, plus 10 per cent. buttermilk powder and 5 per cent. meatmeal, is suggested.

MIXING OF MASHES.

On the majority of farms the various ingredients of a mash are mixed either with a shovel upon the floor of the feed room or in a trough.

If the mash is to be fed wet it is a good practice to soak the lucerne chaff or meal in water. Just sufficient water should be used to bring the mash to the correct consistency. The salt used in the mixture should be dissolved in the water first to ensure even distribution.

In making a dry mixture the salt should be added to the protein-rich foods in order to increase the bulk through which the salt is distributed.

When using cod or other fish liver oil, an even distribution is ensured by first incorporating it in the bran.

Much labour will be saved and better mixing of the various ingredients ensured by using a mash mixer. An appliance that serves the purpose is easily constructed by the poultry raiser. The mixer consists of a drum constructed of 22-gauge galvanised sheet iron with tongued and grooved pine ends, as illustrated in Plate 42. A pipe of 1¼-inch diameter is passed through the centre of the drum, fitting into hardwood bearings at each end. This pipe can be keyed to the drum by boring a hole through the pipe close to the drum and using a piece of No. 8 wire as a key. The wire must be bolted to the drum.

The mash is mixed by a tumbling process; and to assist in raising the mash on the side of the drum while it is revolving, four battens should be attached lengthwise inside the drum 2 inches from the iron. The battens should be of 2½- by 1-inch timber.

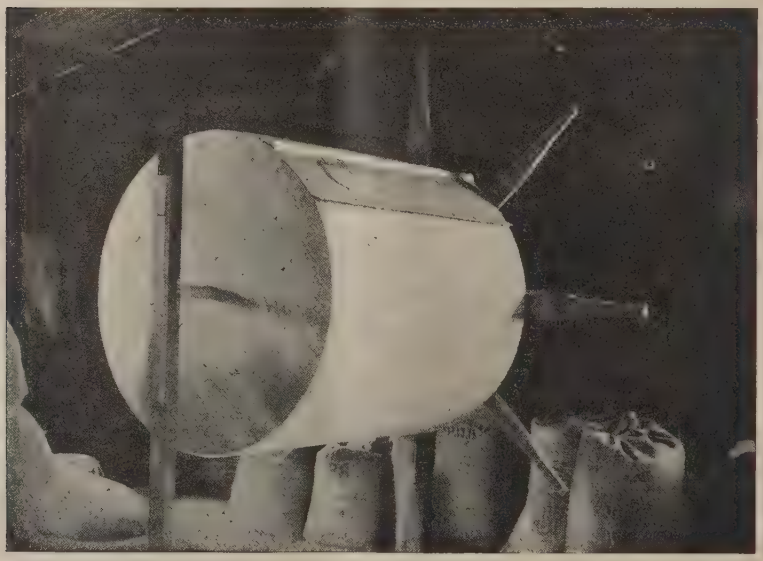


Plate 42.
A Handy Mash Mixer.

The diameter of the drum is 3 feet 6 inches, and the length equal to the width of the iron. The sheet iron to pass around the drum must be riveted end to end, and the sides attached to the pine ends every 2 inches with screws. A convenient sized opening, the full length of the drum, must be left for filling. A sliding close-fitting door must be provided.

FEED HOPPERS.

Hoppers constructed to permit of ready access to the mash by the birds without food wastage are essential for efficient and economic feeding. Self-feeding hoppers which hold a large quantity of food are in general use, and they possess the advantage of economy in labour, as frequent distribution of mash is not necessary; but if these hoppers are not correctly made much feed wastage takes place. They are only suited to the feeding of dry mash. Frequent inspection is essential, as the mash sometimes clogs, and the hopper must be tapped to dislodge it.

The trough type of hopper is suitable for the feeding of both wet and dry mash as well as green feed. Only sufficient feed should be distributed to last the birds one or two days. Fresh mash appears more appetising to the birds, resulting in greater consumption and production. It is also possible from a casual inspection to determine whether the supply of food requires replenishing. The birds should be allowed to consume all the dry mash in the trough at least once per week (although twice is preferred), to ensure that fresh mash is not being placed continually on the top of the stale.

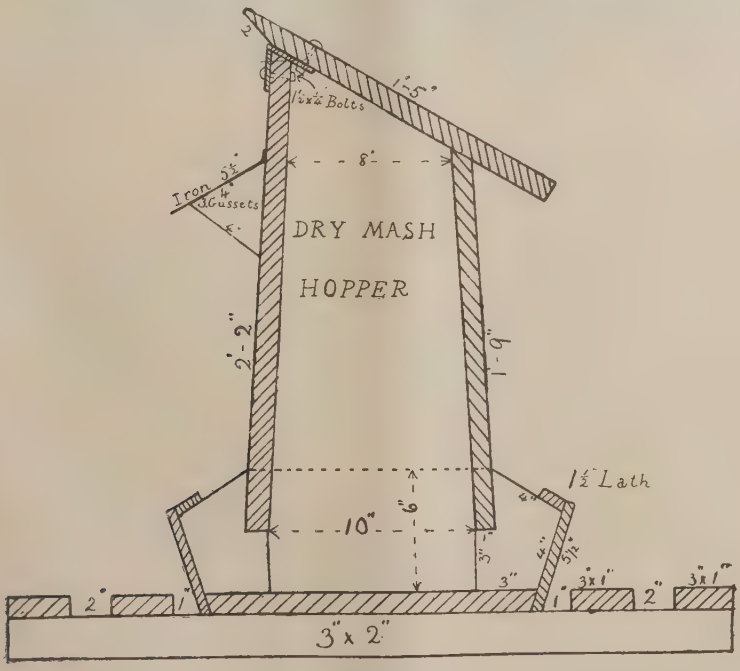


Plate 43.

A Double-sided Self-feeding Hopper.

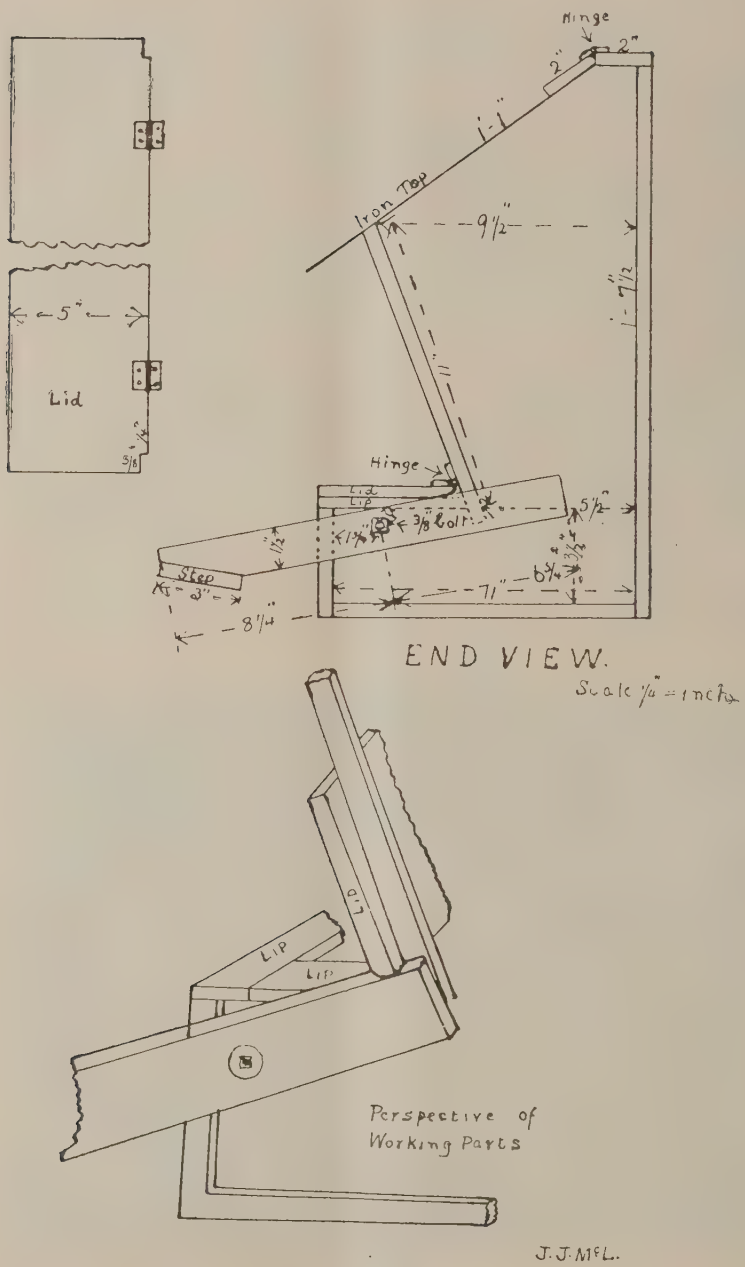


Plate 44.

PLAN OF AN AUTOMATIC FEEDING HOPPER.

Plate 45.
Trough Feed Hopper with Roller Top.

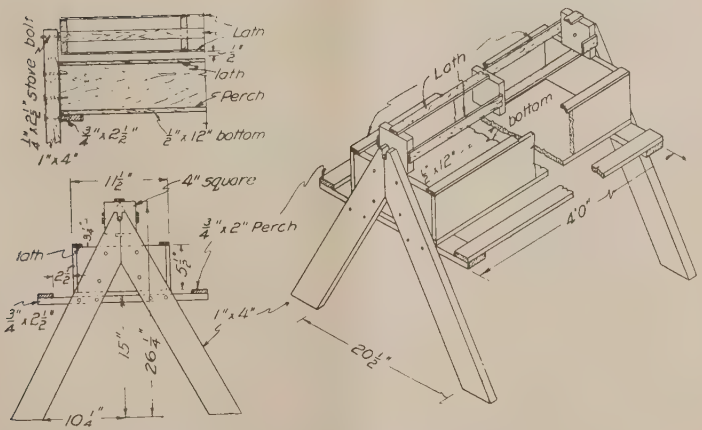


Plate 46.
Plan for the Construction of Trough Hopper Shown in Plate 45.

Plate 47.
Trough Feed Hopper with Slatted Top.

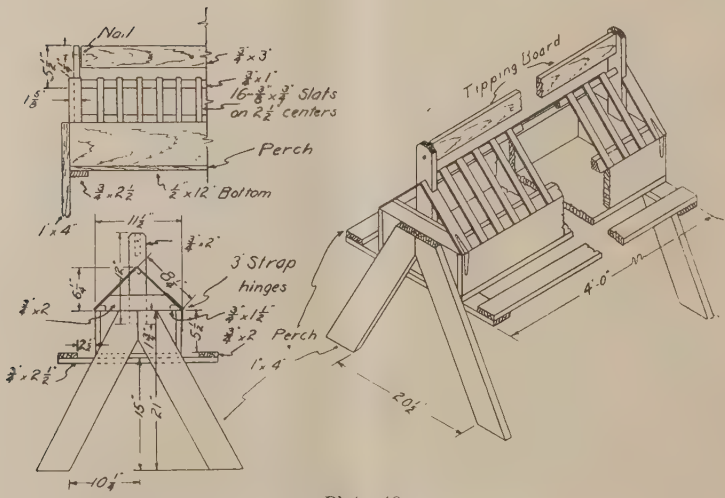


Plate 48.
Plan for the Construction of Trough Hopper Shown in Plate 47.

When dry mash is being fed, 1 foot of hopper space should be allowed for every 10 birds. When feeding wet mash, sufficient space should be provided to permit of all birds feeding at the same time, as the mash should be consumed before it dries out or spoils.

Plate 43 illustrates a double-sided self-feeding hopper that has proved very efficient, and Plate 44 a self-feeder that automatically shuts off the mash when the bird leaves the hopper. Plates 45 and 46 illustrate a trough hopper with a reel over the centre. As small birds are able to gain entrance to the trough between the reel and side, smaller-sized hoppers are required for growing stock. Plates 47 and 48 illustrate a trough hopper with a slatted top. These slats to some extent reduce the feeding space, but they prevent food spoilage and wastage. Hoppers may be made to any length, but it is a good plan to restrict the length in order that one person can readily move an empty hopper. Trough hoppers 4 feet in length are suggested as the maximum, and the double-sided self-feeding hopper should be no longer than 3 feet.

GREEN FEED.

Green feed has long been recognised as an important food for poultry, and fowls of all ages relish it. It is relatively rich in vitamin A and has some feeding value apart from its protein and mineral content. If green feed is used in a wet mash the amount of green feed consumed is increased. It is probably one of the best means of adding bulk to the ration. Its use also improves the hatchability of eggs and the development of growing stock. The young, tender growing portions are the most valuable.

The quantity used depends upon supplies and general conditions. When fed by itself at midday, the birds should be given as much as they will consume, and when incorporated in the mash it may constitute 25 per cent. of the bulk of the mash. The green feed should be placed in hoppers and not thrown indiscriminately about the pens. During droughty periods, when poultry foods have been costly, green feed has been used with success to the extent of 60 per cent. of the bulk of the mash supplied, but as it carries a good deal of moisture the birds are unable to consume sufficient quantities in one feed to obtain their nutrient requirements, and two feeds of such mash should be given during the day with a full evening feed of grain.

As green feed is most suited to poultry when fed in the young succulent stage, a regular supply is only possible with some form of irrigation. The economic installation of an irrigation system is a problem that is best solved by individual producers. Where it is impossible to employ irrigation owing to the cost of plant or the inability to obtain a good supply of suitable water, and where the seasons are against the growing of green feed, substitutes in the form of lucerne chaff or silage are recommended.

Lucerne is probably the best crop to grow where soil and climate conditions or irrigation facilities permit, as it is rich in protein, succulent, easily handled, and responds to repeated cuttings.

In districts where lucerne cannot be grown successfully, the finer-stemmed varieties of cowpea (summer) and field pea (winter) will provide useful substitutes.

TABLE 9.

POULTRYMEN'S CALENDAR FOR GROWING GREEN FEED.

Month.	What to Sow.	Ready to Cut in Approximately—	For Use in—
		Weeks.	
January	Millet	3	January–February
	Buckwheat	3	January–February
	Poona Pea	4	February–March
	Kikuyu Grass	8	All year in frost-free areas
	Paspalum Grass	8	All year in frost-free areas
February	Millet	3	February–March
	Buckwheat	3	February–March
	Poona Pea	4	March–April
	Kikuyu Grass	8	All year in frost-free areas
	Paspalum Grass	8	All year in frost-free areas
March	Oats	3–4	April–May
	Barley	3–4	April–May
	Wheat	3–4	April–May
	Rape	4	April–June
	Field Peas	4	April–July
	Italian Rye Grass	5	May–November
	Wimmera Rye Grass	5	May–November
	Prairie Grass	5	May–November
	Chinese Cabbage	..	..
April	Oats	3–4	May–August
	Barley	3–4	May–August
	Wheat	3–4	May–August
	Rape	4	May–July
	Field Peas	4	May–July
	Lucerne	4–6	All year round
	Italian Rye Grass	5	May–November
	Wimmera Rye Grass	5	May–November
	Prairie Grass	5	May–November
	Chinese Cabbage	..	..
May	Oats	3–4	June–August
	Barley	3–4	June–August
	Wheat	3–4	June–August
	Rape	4	June–August
	Field Peas	4	June–August
	Lucerne	4–6	All year round
	Italian Rye Grass	5	May–November
	Wimmera Rye Grass	5	May–November
	Prairie Grass	5	May–November
	Chinese Cabbage	..	..
June	Oats	3–4	July–September
	Barley	3–4	July–September
	Wheat	3–4	July–September
	Field Peas	4	July–September
	Chinese Cabbage	..	..
July	Oats	3–4	August–October
	Wheat	3–4	August–October
	Barley	3–4	August–October
	Field Peas	4	August–September
	Canary Seed	4	August–September
	Chinese Cabbage	..	..
August	Millet	3	August–September
	Canary Seed	4	September–November

TABLE 9—*continued.*

POULTRYMEN'S CALENDAR FOR GROWING GREEN FEED—*continued.*

Month.	What to Sow.	Ready to Cut in Approximately—	For Use in—
		Weeks.	
September	Millet	3	September–October
	Buckwheat	3	September–October
October	Millet	3	October–November
	Buckwheat	3	October–November
November	Millet	3	November–December
	Buckwheat	3	November–December
	Poona Pea	4	December–January
December	Millet	3	December–January
	Buckwheat	3	December–January
	Poona Pea	4	January–February
	Kikuyu Grass ..	8	All year in frost-free areas
	Paspalum Grass ..	8	All year in frost-free areas

The millets, which include Japanese millet, white panicum and giant setaria, provide useful summer crops. They are quick-growing, nutritious and reasonably fine stemmed. Because of their habit of quick growth, however, successive sowings of millets are necessary to provide succulent feed over the summer season.

Young maize is also valuable, but this crop rapidly becomes coarse.

The winter cereals—wheat, oats, barley, &c.,—are particularly useful in season, and will provide excellent feed over a long period. Rape is also suitable for autumn sowing and may be fed to poultry without chaffing.

Although grasses are primarily suitable for open range, succulent grasses, such at kikuyu and paspalum (sown from December to February) and rye and prairie (sown late March to May) will provide cuttings of nutritious, easily-handled green food.

Information on green crops is summarised in Table 9.

GREEN FEED SUBSTITUTES.

Lucerne Chaff.

Lucerne chaff has been found an excellent substitute for green feed. It possesses most of the qualities of good green feed, being a relatively valuable source of vitamin A and minerals and containing some vitamin D. All lucerne chaff has not the same value, and the choicest lines are the most desirable for use in the feeding of poultry. Leafy lucerne of a good green colour is a good source of vitamin A, whilst lucerne that is bleached contains virtually none. The important factor of fibre content, together with the protein value, is illustrated in the following analyses:—

	Protein. Per cent.	Fibre. Per cent.
Choice leafy lucerne chaff ..	18 to 22 ..	25 to 28
Good lucerne chaff	16 to 20 ..	27 to 30
Poor lucerne chaff	10 to 12 ..	31 to 35

Lucerne chaff for poultry should be finely cut to obtain the maximum consumption of the quantity supplied. When grain is fed it can be incorporated in the mash to the extent of 10 per cent. If the mash is to be fed in a moist state, the lucerne should be soaked before use, the time of soaking being arranged to suit the convenience of management. The quantity of water used for soaking should be just sufficient to mix a crumbly mash. This is the most economical method of using lucerne chaff as a green feed substitute.

Silage.

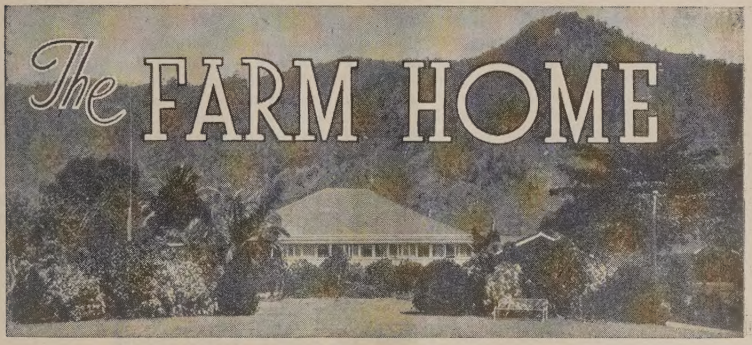
The feeding of silage as a substitute for green feed has proved very satisfactory in experiments conducted in the United States of America. Queensland poultrymen who have had some experience with silage speak highly of it. Silage may be made of many kinds of green feed. Legumes would undoubtedly prove the most nutritious, but barley, oats, lawn clippings, &c., will also make good silage.

Method of Preparation.—As silage for poultry is made from young growth rich in protein, it is necessary to add molasses. The material to be used should be cut, while still fresh and succulent, into lengths of about half an inch. Failing concrete silos, barrels or drums of a capacity of about 40 gallons may be used. Immediately after cutting, the material should be packed tightly in to the silo, which should be filled to the top. To each 40-gallon drum of material 2 gallons of molasses thinned with water (usually about 2 gallons) are poured over the top. The quantity of water is largely governed by the wilting that has taken place before chaffing. A weight of about 150 lb. to 200 lb. should be applied to the top of the silage, and it should then be left to stand for some time. Considerable settling down will take place permitting of more material being added the next day, after which the weight should be again applied. After a little more settling down has taken place the silo should be sealed. This is one of the most important points in the manufacture of silage. The most satisfactory procedure to adopt is to cover the silage with tarred paper or other waterproofed covering and place over it puddled clay to a depth of 2 to 3 inches. This should be inspected after about two days and again at intervals. Any cracks which appear on its surface or between the drum and the clay should be plastered with more clay. With properly sealed silage the material used retains its colour, the juices are conserved, and the development of moulds and insect larvae is checked. The development of these would make the use of the silage dangerous.

Method of Feeding.—Though they usually take to it readily, poultry may have to be accustomed to silage. The best method of introducing it to their ration is to mix it with the mash. Once they have become accustomed to it, silage may be fed as a green feed. It will be freely consumed, but 1 to 2 quarts per 100 birds will be found sufficient.

Effects of Feeding—The quality of the eggs produced by birds fed on silage is not affected, nor have any other effects depreciating its value as a poultry food been noted.

[TO BE CONTINUED.]



Leg Troubles in Toddlers.

After the thrill and joy of watching their infants gain their feet and then begin to walk unaided, many parents become concerned because "Johnny" walks with his toes turned in; he walks clumsily and frequently falls over; his legs are not straight, or his knees are knocking together.

These are very common complaints in toddlers and may or may not be of serious import for the future well-being of the child.

The causes of these defects are as yet imperfectly understood, but it is generally agreed that the milder degrees of defect may merely signify different stages in the developmental growth of the child's bones and muscles, and therefore spontaneous correction will most likely take place as the child grows older. But Nature must be assisted, or at least not hindered, and it is important to make sure that the child is in good general health; that he is receiving a diet adequate in quantity and quality, with especial emphasis on an adequate amount of protein, minerals, and vitamins; that he gets plenty of fresh air, sunshine, and exercise; and that he wears sensible shoes.

In the shaping and development of the bones, muscles have an important part to play, so it is essential that the muscles and ligaments themselves should be well developed, strong, and healthy. Many of the above distortions in toddlers' legs are caused or aggravated by lack of proper support from soft and flabby muscles and lax ligaments. What is often forgotten is that a child's bones and muscles and other growing tissues obey the same laws as do trees and other plants. It is not surprising to find the young tree arching at the behest of the prevailing wind and the old gnarled trunk bent irreparably, yet many are surprised to find a knock knee increasing instead of "being grown out of" when the child walks daily on an unyielding pavement, on the inner strap of a sandal which offers no grip to the foot muscles and allows the inner border of the foot to lie constantly on the ground.

It is important that steps to correct these faults should be taken early if the toddler is to be spared the handicap of having to wear leg irons or braces, or the necessity of operation, or, if left incorrected, ugly deformity and maybe painful arthritis in later life.

The toddler may require some additions to his diet, more sunshine, fresh air and exercise, sensible footwear. Perhaps his shoes require wedging or building up, and it is important that when a doctor prescribes built-up shoes, or better still, boots, they be worn all day and every day. Boots should be firm, fitting snugly round the ankles, with broad toes and a straight inner border.

Some special exercises are most helpful in developing and strengthening the muscles of the feet and legs and can be incorporated into the parents' playtime with their children.

Exercises.

For the Muscles of the Feet—

Encourage the toddler to actively arch his feet, claw his toes and pick up pencils or marbles with his toes.

Let him imitate you, walking on the outside edges of the feet.

If he is too young to do these tricks, tickle the arch muscles of the soles of his feet and they will contract.

For the Muscles of the Legs—

The child sits on the floor in the cross-legged position facing his mother (or father), who sits on a chair. She places her right foot as a steadying block against the inverted sole of the right foot of the child and her left to his left. She then clasps his outstretched hands and teaches him to rise slowly to the upright position, and then return slowly to the sitting position, keeping the legs crossed and inverted all the time. At first she takes most of his weight, but less and less, until he can do the exercise without assistance.

At two years or a little later the tricycle serves as good exercise for the leg and thigh muscles. The wooden bar which runs from the seat to below the handle-bars should be well padded, so that the child shoves on the pedals with the knees well apart and the legs and feet inverted.

The more fortunate child with a pony has the perfect apparatus for the correction of any tendency to knock knees.

The Battle of Food in Early Childhood.

Many modern mothers study scientific methods of feeding their children and are well versed in the principles of child nutrition and dietetics, but when it comes to putting these principles into practice many difficulties and problems are encountered.

Children, especially at the toddler stage, are all individualists and rarely conform to set rules and patterns. Their behaviour and actions are governed more by fundamental instincts and emotions than by convention, knowledge, and reason. The habits of adulthood appear automatic, subconscious, and effortless, but not so to the child, who has yet much to learn and many emotional conflicts to resolve.

The setting in which difficulties occur is of prime importance, for over food the young child can most easily try to attract attention to himself or try to dominate his parents. The child who is insecure or who feels neglected from any cause, be it family dissension, illness or loss of a parent, or a new addition to the family, will often retaliate by scenes at meal times. So will the child who is over-pampered, fussed over and spoilt and who always expects and usually gets his own way. So it will be seen that food fads are fairly common among young children and may include many forms of refusal such as finickiness, refusal of specific foods or general negativism over all meals. It is important that mothers and fathers should understand these problems so that they may be resolved sanely and calmly and not aggravated by emotional and unwise management which leads to further anxiety for all concerned.

The growth of anxiety in regard to feeding can readily be observed. The baby may not be hungry. Perhaps his gums are sore from teething. He refuses his orange juice. His mother spoons it in and the rim of the spoon knocks his sore gums. He chokes a little and the back of his throat hurts him. He screams and upsets the orange juice. His mother thinks he is just being tiresome, holds him tightly, and forces it between his lips. He may vomit a little and get wind, and so there are more screams and struggles. The battle of food has started. Next time he may remember the struggle and prepare for another—so he refuses his milk. Thus it may go on and his devoted and well-meaning mother becomes anxious lest he should lose weight. She may even summon the doctor. How much better to have waited until the baby was ready *and* hungry than to try forceful feeding. It is a mistake to allow your emotions to enter into the matter at all. This kind of anxiety is often cumulative. The child earns the reputation of a poor eater, and the mother urges, coaxes, cajoles, threatens, scolds, and finally trys to force. The child usually retaliates by vomiting or by indigestion.

Many children who refuse to eat at home will eat well at nursery school. This is not only because convention decrees it, and the teacher's attitude prevents an emotional issue arising, but also because the example of the other children is reassuring.

It is not surprising that it is the *eldest* or the *only* child of anxious parents who tends to exhibit food fads most frequently. It is natural enough that this should happen.

Unemotional unconcern is by far the best and safest cure unless the child is in poor physical health, when medical advice should be sought. It is also necessary to make sure that your child gets plenty of fresh air and exercise, that this is balanced with sufficient rest, that he does not get over-excited, that he has a quiet period before meals, and that his bowels are functioning normally.

Any further information on this and other matters connected with children may be obtained by communicating personally with the Maternal and Child Welfare Information Bureau, 184 St. Paul's Terrace, Brisbane, or by addressing letters "Baby Clinic, Brisbane." These letters need not be stamped.

ASTRONOMICAL DATA FOR QUEENSLAND.

SEPTEMBER, 1949.

Supplied by W. J. Newell, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	6.03	5.33	Cairns	27	31	Longreach	34	36
6	5.58	5.36	Charleville ..	27	27	Quilpie	35	35
11	5.52	5.38	Cloncurry	48	52	Rockhampton ..	9	11
16	5.46	5.40	Cunnamulla ..	29	29	Roma	17	17
21	5.40	5.42	Dirranbandi ..	19	19	Townsville ..	22	27
26	5.35	5.45	Emerald	18	20	Winton	38	42
30	5.30	5.46	Hughenden ..	33	37	Warwick	3	4

TIMES OF MOONRISE AND MOONSET.

At Brisbane.		
Day.	Rise.	Set.
	a.m.	a.m.
1	11.38	1.20
	p.m.	
2	12.36	2.21
3	1.36	3.16
4	2.36	4.04
5	3.35	4.45
6	4.32	5.20
7	5.27	5.51
8	6.20	6.20
9	7.11	6.47
10	8.03	7.13
11	8.56	7.41
12	9.50	8.10
13	10.46	8.43
14	11.44	9.21
15	..	10.04
	a.m.	
16	12.43	10.54
17	1.40	11.51
		p.m.
18	2.33	12.54
19	3.22	2.01
20	4.07	3.09
21	4.47	4.17
22	5.23	5.25
23	5.59	6.33
24	6.35	7.42
25	7.12	8.51
26	7.54	10.01
27	8.40	11.10
28	9.32	..
		a.m.
29	10.29	12.15
30	11.29	1.12

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19;
Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	30	9	46	24	21	0	54	26
6	25	13	41	28	16	3	47	32
11	14	23	29	39	4	14	33	45
16	9	30	25	45	0	21	26	54
21	14	23	29	39	4	14	33	45
26	27	11	43	26	18	0	51	29
30	30	9	46	23	21	0	54	26

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	56	3	68	32	52	18	46	4
3	55	2	68	32	51	17	45	3
5	47	8	63	36	47	21	39	8
7	37	18	55	43	40	27	31	17
9	27	29	49	50	33	35	23	25
11	17	38	41	57	26	42	15	33
13	8	48	36	62	21	48	8	40
15	5	55	35	67	19	52	5	45
17	2	56	33	67	17	53	3	46
19	7	49	36	63	20	49	7	41
21	17	38	41	57	26	42	15	33
23	29	25	50	47	35	32	25	22
25	43	12	59	38	44	24	36	12
27	53	3	67	32	50	18	44	4
29	57	2	69	32	53	17	47	3
30	56	2	68	32	52	17	46	3

Phases of the Moon.—Full Moon, 7th September, 7.59 p.m.; Last Quarter, 16th September, 12.29 a.m.; New Moon, 22nd September, 10.21 p.m.; First Quarter, 29th September, 2.18 p.m.

On 23rd September at 7 p.m. the Sun will cross the Equator on its apparent journey from North to South. It will then rise and set at true east and true west respectively. On the 9th and 23rd September the Moon will rise and set approximately at true east and true west respectively.

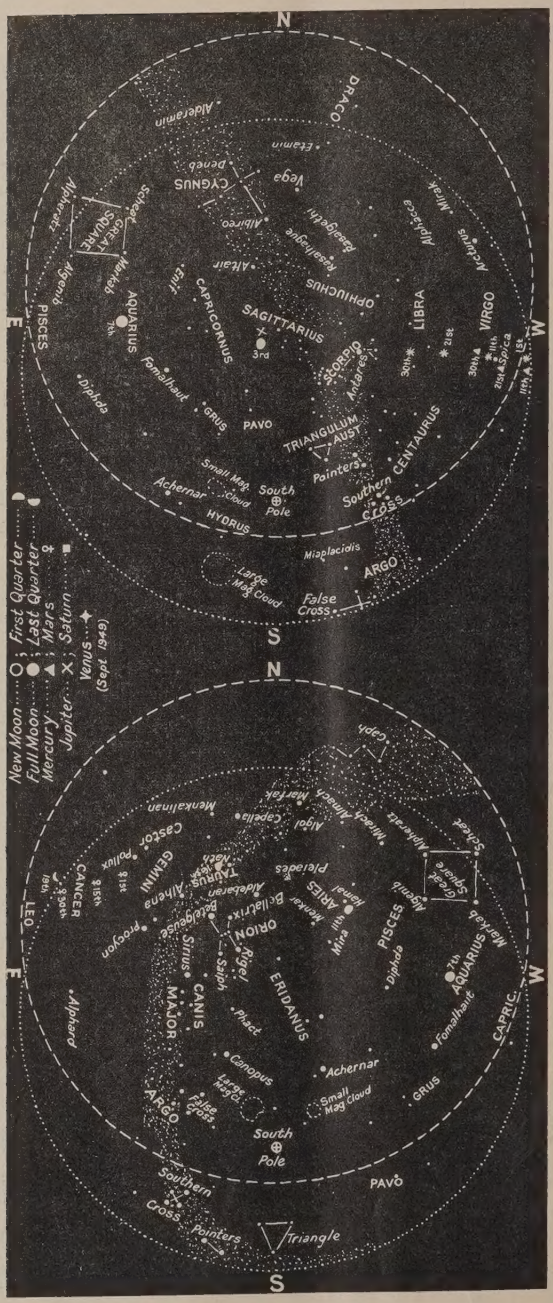
Mercury.—An evening object all this month. At the beginning of September, in the constellation of Virgo, it will set about 2 hours after the Sun and by the end of the month, still in the constellation of Virgo, it will set half an hour after the Sun.

Venus.—At the beginning of the month, in the constellation of Virgo, will set about 2¾ hours after the Sun and at the end of the month, in the constellation of Libra, will set about 3¼ hours after the Sun.

Mars.—In the constellation of Cancer, will rise about 2¼ hours before Sunrise at the beginning of September, and about 2½ hours before the Sun at the end of the month.

Jupiter.—Still a conspicuous object in the evening sky, being almost overhead at nightfall. On the 1st it will set about 4 hours after midnight and on the 30th about 2 hours after midnight.

Saturn.—Now too close in line with the Sun for observation.



Star Charts.—The chart on the right is for 7.15 p.m. in the south-eastern corner of Queensland to 8.15 p.m. along the Northern Territory Border on the 15th September. (For every degree of Longitude we go west, the time increases 4 minutes.) The chart on the left is for 9 hours later. On each chart the dashed circle represents the horizon as viewed from Cape York and the dotted circle is the horizon for places along the New South Wales border, when facing north hold "N" at the bottom; when facing South hold "S" at the bottom; and similarly for the other directions. Only the brightest stars are included and the more conspicuous constellations named. The stars, which do not change their relation to one another, moving east to west arrive at any selected position about 4 minutes earlier each night. Thus, at the beginning of the month the stars will be in the positions shown about 1 hour later than the time stated for the 15th and at the end of the month about 1 hour earlier than that time. The positions of the moon and planets, which are continually changing in relation to the stars, are shown for certain marked days. When no date is marked the position is for the middle of the month.